SPECIAL DOUBLE MAP SUPPLEMENT: JAPAN AND ITS HISTORY

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Enter the naked mole rat ... a sausage with teeth

IT DOESN'T RANK with pandas for cuteness, with lions for majesty, or with snow leopards for rarity. But the naked mole rat is significant, even if it looks like a sausage with teeth. It also exemplifies a continuing frustration for us at the Society.

For every 25 of the research projects the Society supports—these number nearly 200 a year with a total budget of about three and a half million dollars—only one will be reported in NATIONAL GEOGRAPHIC or our other publications. Some of the projects are too specialized to be of general interest. Some don't lend themselves to photography.

Enter the naked mole rat. The Society has helped support the work of Jennifer U. M. Jarvis, Paul W. Sherman, and Richard D. Alexander in their collection and study of this remarkable rodent—remarkable because in its colonies it resembles highly social insects, and in its metabolism reptiles.

Native to East Africa, naked mole rats live underground and have an extremely low metabolic rate. They burrow through hundreds of meters of dirt barely softer than concrete "like an endless conveyor belt of moving mole rats pushing inexorably forward," according to Dr. Jarvis.

Most unusual among mammals is a trait they share with ants and bees: Only one female mole rat in a colony breeds.

This queen, probably through behavioral and chemical signals, controls the apparently peaceful and cooperative mole rat society. Should she be removed, however, chaos may ensue and continue until another female asserts her dominance as the new mole rat queen.

With colonies established at the University of Cape Town, Cornell, and Michigan, the scientists should learn a great deal more. Naked mole rats are at one end of a spectrum of mammal social behavior. For this reason, they should make excellent examples against which other mammal behavior and adaptation can be compared.

The scientists' multiple backgrounds in studying insects, birds, and mammals, and in physiology, behavior, and systematics, will help in their search for understanding.

Studies are often given the designation "interdisciplinary"; the term has become almost a one-word cliché. Not in this case. The naked mole rat is interdisciplinary by its nature, a through-the-looking-glass animal that happens to chirp like a chick when disturbed or when communicating with other members of its colony. Support for the work is also interdisciplinary, having come from the researchers' universities as well as the National Geographic Society.

Naked mole rats might have continued in

PHOTOGRAPH BY CHRISTOPHER SPRINGMANN

their customary obscurity except for the Society's News Service, which regularly writes features and distributes them to hundreds of publications at no charge. Don Frederick's story on the animal caught editors' fancy. Within a few weeks at least 50 papers from Boston to Big Spring, Texas, printed it, and two science magazines featured the rodent. This helped ease our frustration at not finding the room to publish our own story. More important, we transmitted results of Society-supported research to a large audience.

I am tempted to say that the rodent has had its day in the sun, but if there is one thing naked mole rats don't often see, it's the sun.

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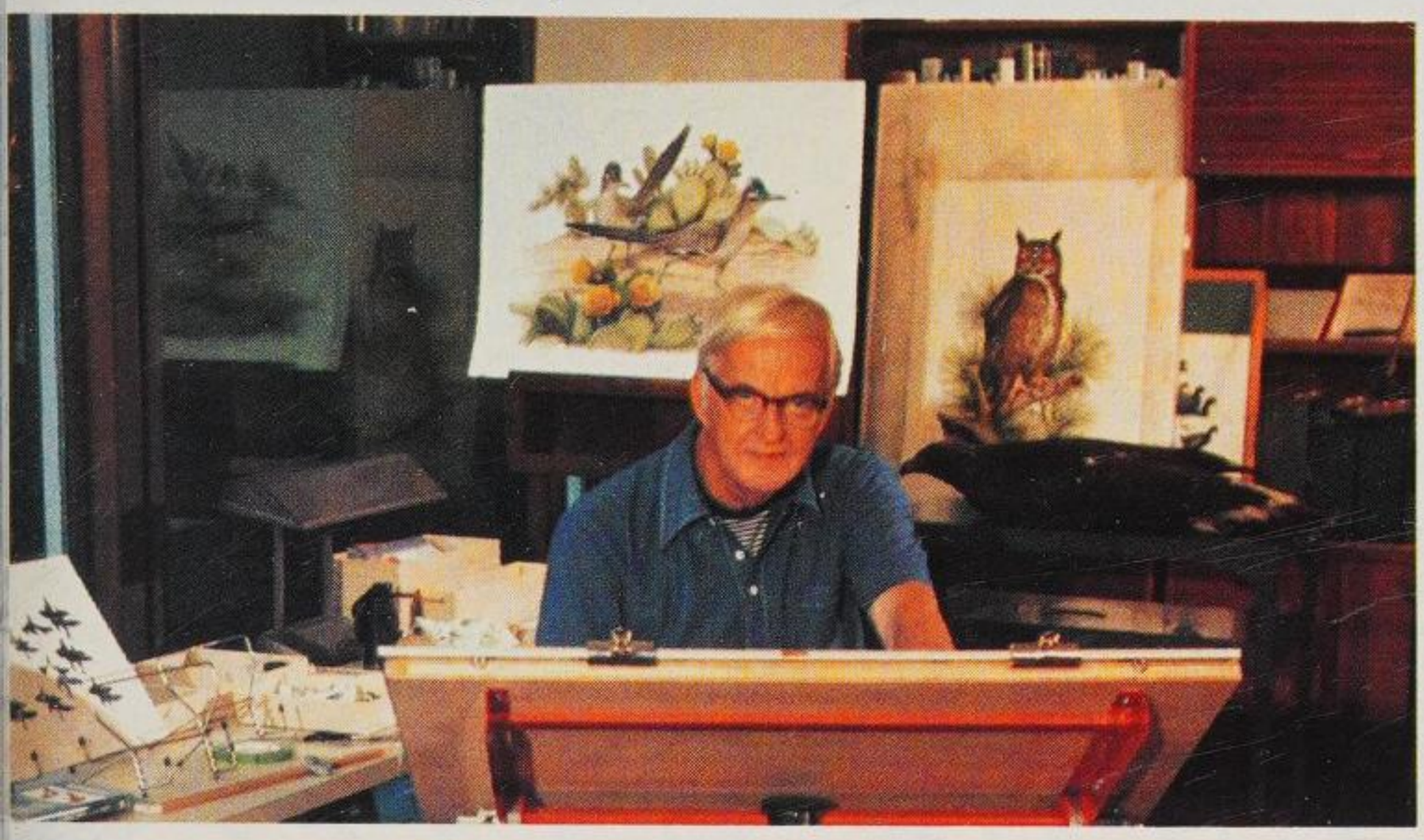
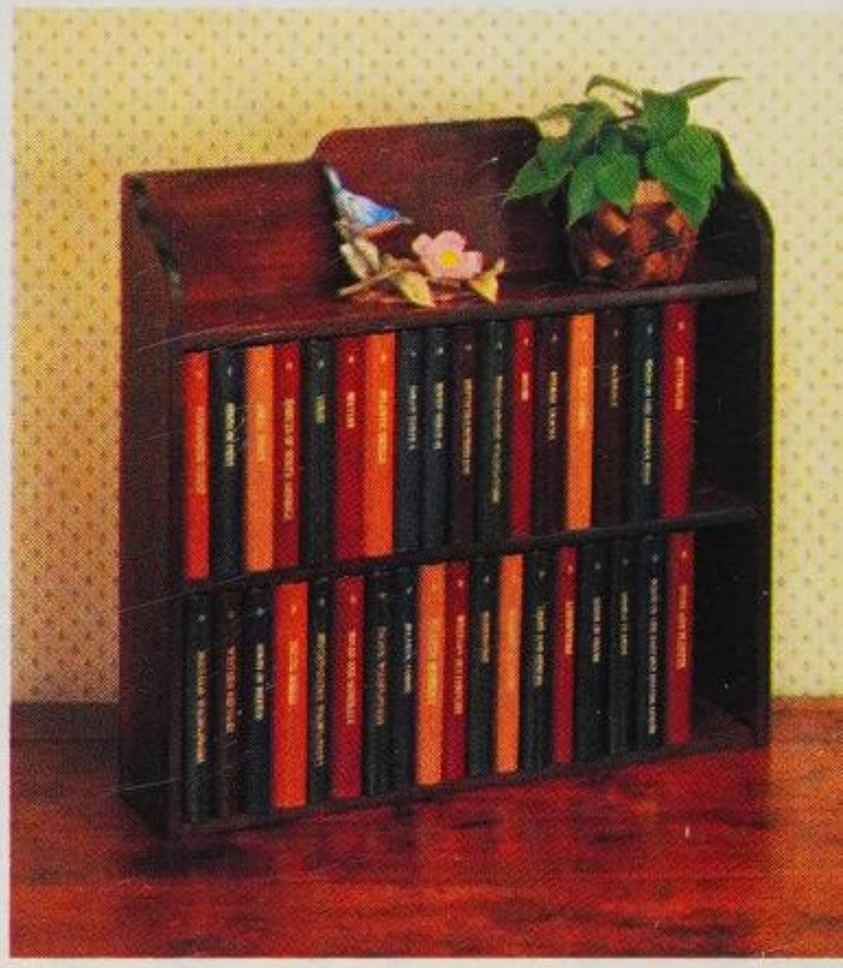


Dr. Peterson, America's greatest living bird artist, at his Connecticut studio.



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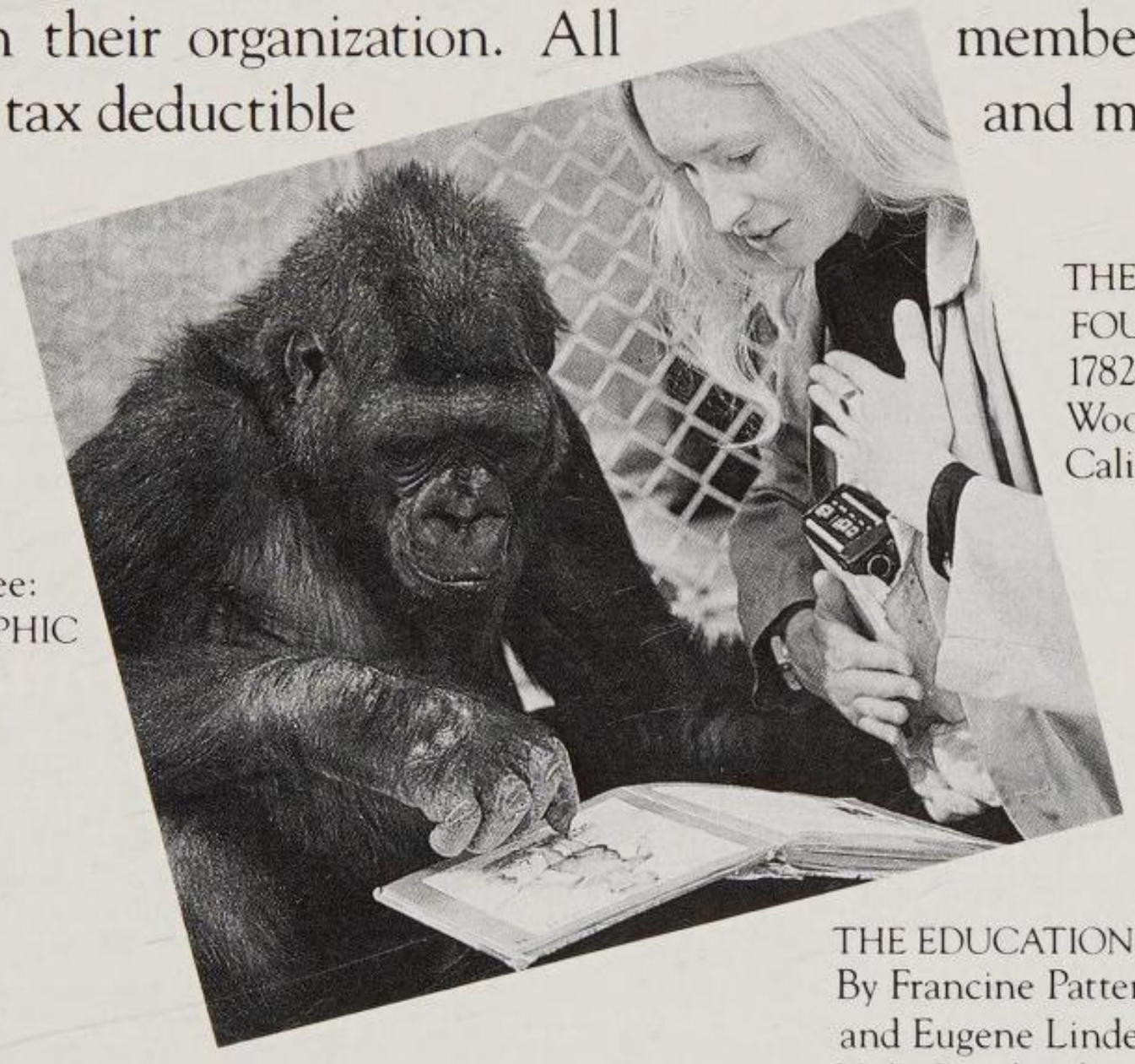
We've learned, for example, that Koko and Michael, two lively lowland gorillas, are highly sophisticated animals capable of humor, modesty and affection. Using American Sign Language, the conversations have been lively and complex. We've had them cuss us out, we've caught them lying, and we've seen them create names for objects and concepts that were new to them. ☐ The research is adding to our understanding of the great apes–particularly the seriously endangered gorilla–which will further our goal of encouraging the protection, preservation and propagation of anthropoid apes. The benefits for humans are in the teaching methodologies we use that can be applied to helping autistic children, the severely retarded, and other handicapped individuals with whom communication is difficult. ☐ The demands of the research create substantial ongoing financial needs that can be met only through contributions and memberships in the Gorilla Foundation which includes a subscription to our Journal. Michael and Koko would be pleased to welcome you into membership in their organization. All memberships, which start at $15, are tax deductible and may be sent to:



THE GORILLA
FOUNDATION
17820 Skyline Boulevard
Woodside
California 94062

For more information on the work of the Gorilla Foundation, see: NATIONAL GEOGRAPHIC October, 1978, "Conversations with a Gorilla."

THE EDUCATION OF KOKO
By Francine Patterson
and Eugene Linden
Holt, Rinehard and Winston, 1981
Available for $15 through the
Gorilla Foundation

WHAT WE'RE LEARNING FROM THEM STAGGERS THE IMAGINATION.

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As a maker of home appliances, Whirlpool Corporation understands how important the home is to millions and millions of people. We know that it gives them a place of shelter, a source of pride and a sense of accomplishment. We also know that major home appliances go a long way toward making a house a home. This is why we promise to build and sell only good quality, honest appliances designed to give you your money's worth…and to stand behind them. We stand behind them by offering programs that include our Cool-Line® service, Tech-Care® service and helpful do-it-yourself repair manuals.

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Members Forum

Jordan

The article about Jordan (February 1984) was excellent, but I was surprised at Thomas Abercrombie's need for two passports to avoid an Israeli stamp in one in case he wished to return to an Arab country. When my wife and I crossed the King Hussein (Allenby) Bridge from Jordan in October 1982, the Israeli border guards stamped a piece of paper and inserted it in her Canadian and my U. S. passport. This allowed us to return to other Arab countries, including Syria.

Edward P. Kinney
El Cerrito, California

People who cross the border often, such as journalists and businessmen, usually carry double documents to avoid delay and to ensure that their "real" passport is not stamped by mistake, a recommendation of the U. S. Department of State.

While it may be true that the West Bank is not Israel, it is also not Jordan. Jordan took it by conquest in 1948, as Israel occupied it in 1967. It was supposed to be part of the Arab state carved out of Palestine west of the Jordan River. There is some question whether material on the West Bank, or Judaea and Samaria, belongs in an article on Jordan at all.

Rabbi George M. Stern
Valley Cottage, New York

The caption on page 260 of the February issue refers to the mass suicide of the last Jewish defenders of Herodium. This actually took place on Masada in A.D. 73. Its defenders, almost a thousand men, women, and children, chose to commit suicide rather than fall into Roman hands.

Sheldon Somerstein
Bayside, New York

On page 260 the picture obviously shows Masada, the Jewish fortress that fell to the Romans in A.D.73 after the 960 Zealot defenders, rather than surrender, committed mass suicide. This is well documented and reported by the historian Josephus Flavius.

Hans E. Schapira
New York, New York

We did not move Masada to the West Bank, as some of our readers have suggested. The photograph is of Herodium, one of the last three fortresses held by the Zealots, the other two being

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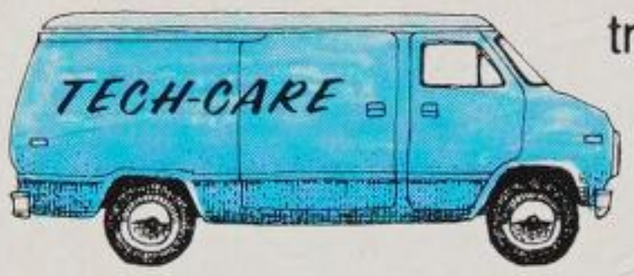

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Machaerus and Masada. The Jewish historian Josephus states that a Roman army "took that citadel which was in Herodium together with the garrison that was in it." However, there is a persistent story on the West Bank that a heroic defense similar to that at Masada occurred at Herodium. Since we could not confirm it, we said that it is a story.

Italy

In your February 1984 article on Italy, you report a small conspiracy in the making, supposedly overheard in a Florence restaurant. I am truly impressed by Mr. Ellis's fluency in Italian, so seldom found among Americans. If the conversation truly had happened, I am sure it would have been whispered. Such presumed conspiracy well fits the main theme of the article, striving to portray the common view of Italians as a people on a cheating spree. In dedicating your article to cheaters, smugglers, and nouveaux riches, you have typically neglected the majority of hard-working, honest Italians who do not accept the obvious shortcomings in their society as complacently as you do.

Mario V. Bonaca
Glastonbury, Connecticut

In regard to the sterling article "Surviving, Italian Style" by William S. Ellis, I commend your

Come to Canada.

Victoria, British Columbia

magazine for the pluck to print such a lucid and candid report. My own work takes me into the "deeper" socioeconomic and political realms of foreign nations and cultures, and I can readily attest to the veracity of Mr. Ellis's article. In an era marked by mis- and disinformation and by overly simplistic views, such astuteness is refreshing. My one regret, as a native Sardinian, is that he didn't include my homeland in his article. Otherwise, *nota bene!*

Natalino Morrocu
Philadelphia, Pennsylvania

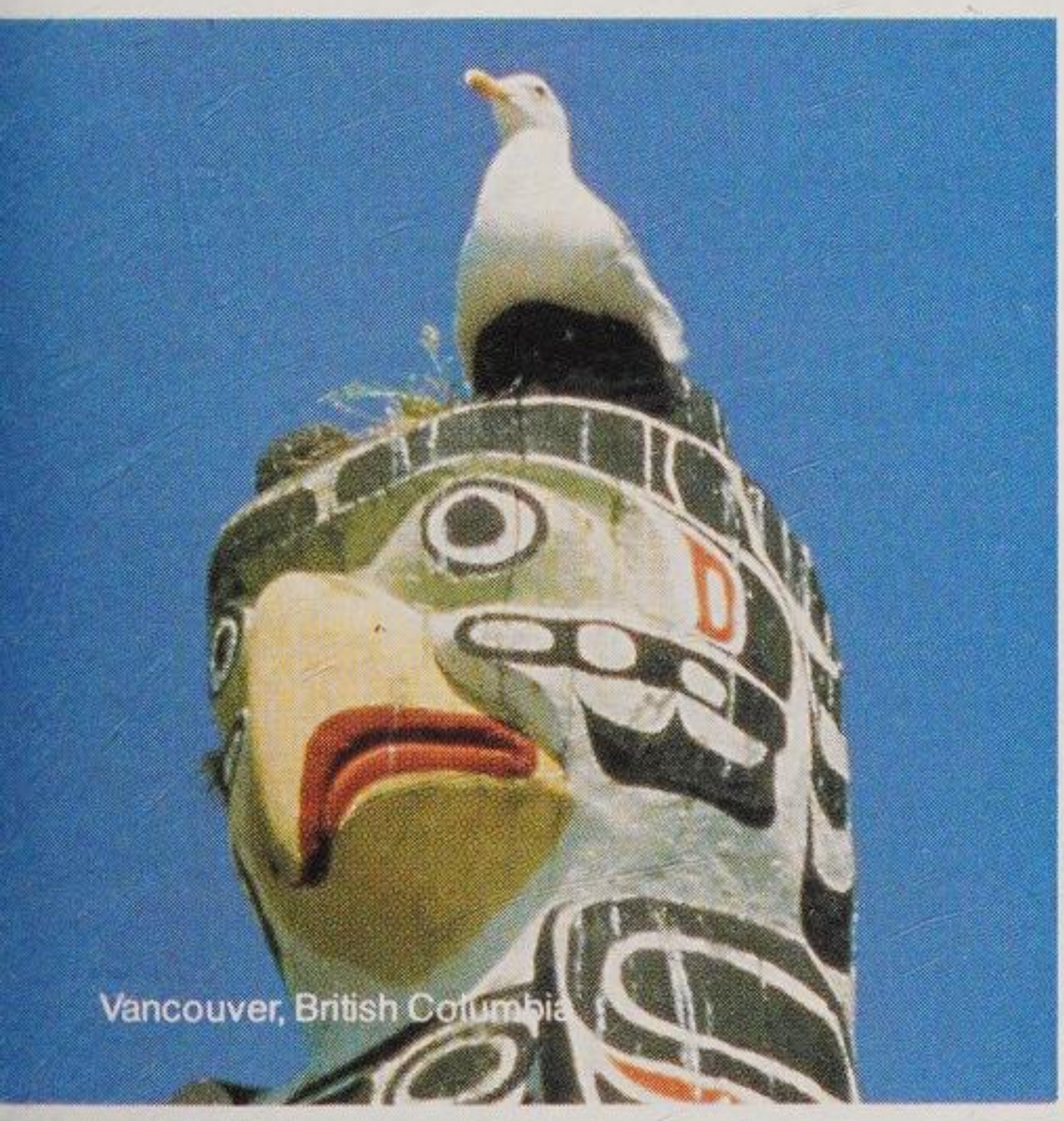
Your article on "Surviving, Italian Style" is outstanding. Rarely have I read such a well-balanced and intelligent portrait of my people.

Tony V. Pancotto
Winnipeg, Manitoba

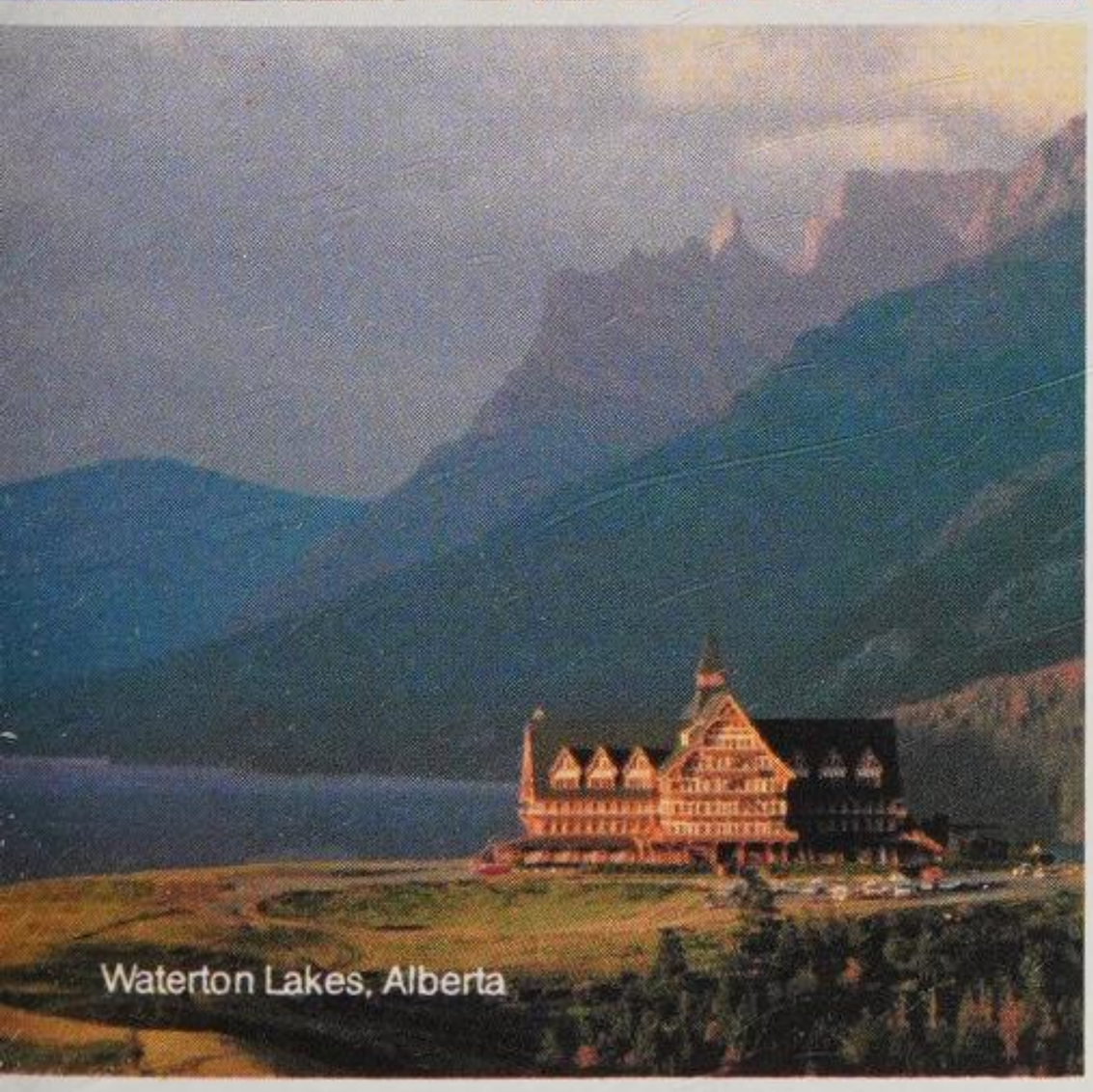
West Texas

The thing I like about the NATIONAL GEOGRAPHIC is the articles each month reflecting the regional differences of people and places. The February 1984 piece about West Texas was a good example—and clearly shows why America is such a unique place with a real history of its own. The people who populate the harsh country of western Texas, Oklahoma, Kansas, Nebraska, and South Dakota contribute much to our nation's rich heritage and still retain many of

The Endless Surprise.


Vancouver, British Columbia

Fort Macleod, Alberta


Waterton Lakes, Alberta

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AMERICA BORDERS ON THE MAGNIFICENT

Canada

the qualities most of the world admires in Americans.

William M. Kunkle
Eugene, Oregon

Oh, what a wonderful story on Trans-Pecos, Texas, by Griffin Smith, Jr., and Dan Dry! It read like a novel that should be made into a movie. Fascinating, interesting, nostalgic—wonderful descriptions of folks and towns and quiet living.

Mrs. Jack Nover
Huntington Woods, Michigan

El Niño

Although El Niño (February 1984) has reshaped the earth with erosion and rain, it certainly hasn't washed the city of Portland from the banks of the Willamette to the shores of the Pacific. To imagine barracudas prowling off Portland would be the equivalent of wahoos wallowing off Walla Walla, since both cities are a considerable distance from the nearest salt water.

Oregon, along with a record-breaking rainfall for 1983, felt the ocean-warming effects of El Niño strongly. Marine harvests were the worst in years, and agricultural products also suffered, resulting in loss of income and outward migration. Economically, Oregon will recover from El Niño. Geographically, it will be more difficult to return the city of Portland to its original site.

George D. Furness
Gresham, Oregon

Barracudas prowled that far north, but not inland. Our apologies; we did not intend to move Portland to the sea, like its counterpart in Maine.

In his interesting and otherwise accurate article, the author completely forgot to mention an area that suffered damages and losses at least equal but probably worse than those sustained in other areas mentioned. In southern Brazil alone, more than 400,000 people were left homeless in July. Most crops, thousands of businesses and factories, roads and bridges, even whole cities were devastated. The immediate cause: El Niño affected a jet stream that crossed Brazil and prevented the cold fronts that normally move in from Patagonia to proceed on their normal path to the north. Thus the fronts discharged their rain loads over southern Brazil, where it continued to rain until the next cold front arrived with even more rain. It rained for six months!

Roberto E. Leyendecker
Santa Catarina, Brazil

Recent data, analyzed after we went to press, suggest that not only the extensive rains but also the very dry conditions of 1982-83 in northeast Brazil may have been caused by El Niño.

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Praying Mantis

Hooray for an exciting and beautiful article on insects. Nonetheless, I wonder if this article is not needlessly perpetuating the myth that "a male [mantid] often ends up as a meal as well as a mate." In writing a chapter on mantid behavior, I searched through all possible scientific literature on mantid mating. As far as I could tell, it is the exception rather than the rule that male mantids are eaten by their feisty, voracious mates. One worker reported that mate cannibalism is probably a result of artificial lab conditions and disturbances.

Since 1975, we have studied Chinese mantids mating in the lab. Out of about 50 pairs, about five involved females eating their mates, but this was under artificial conditions. I have seen about 20 mating pairs of Chinese mantids and studied their prey in nature since 1975, but have never seen evidence of mate cannibalism.

Edward M. Barrows
Georgetown University
Washington, D. C.

Much of the written material on mantids is based on laboratory studies. Most of Dr. Ross's observations have been in the wild. He and other authorities consulted agree that the male "often" ends up the victim of mate cannibalism.

Last summer among my blooming cosmos I had a pet praying mantis (February 1984)—she allowed me to gently stroke her back. One day I noticed a commotion and quickly snatched a hummingbird from that clutching mantis. The bird lay in my palm—whoever dreamed of holding a hummingbird in one's hand. I placed the bird among the ivy vines—it soon recovered and was away.

Lucy C. Warner
Poca, West Virginia

My wife and I especially enjoyed your interestingly written and beautifully photographed article about the mantids, since we follow their antics regularly on our own shrubs and plants.

Unconfirmed reports here state that University of Florida entomologists have succeeded in mating a praying mantis with a termite, thereby producing a bug that says grace before starting to eat your house.

C. Calkin
St. Augustine, Florida

Letters should be addressed to ***Members Forum,*** *National Geographic Magazine, Box 37448, Washington, D. C. 20013, and should include sender's address and telephone number. Not all letters can be used. Those that are will often be edited and excerpted.*

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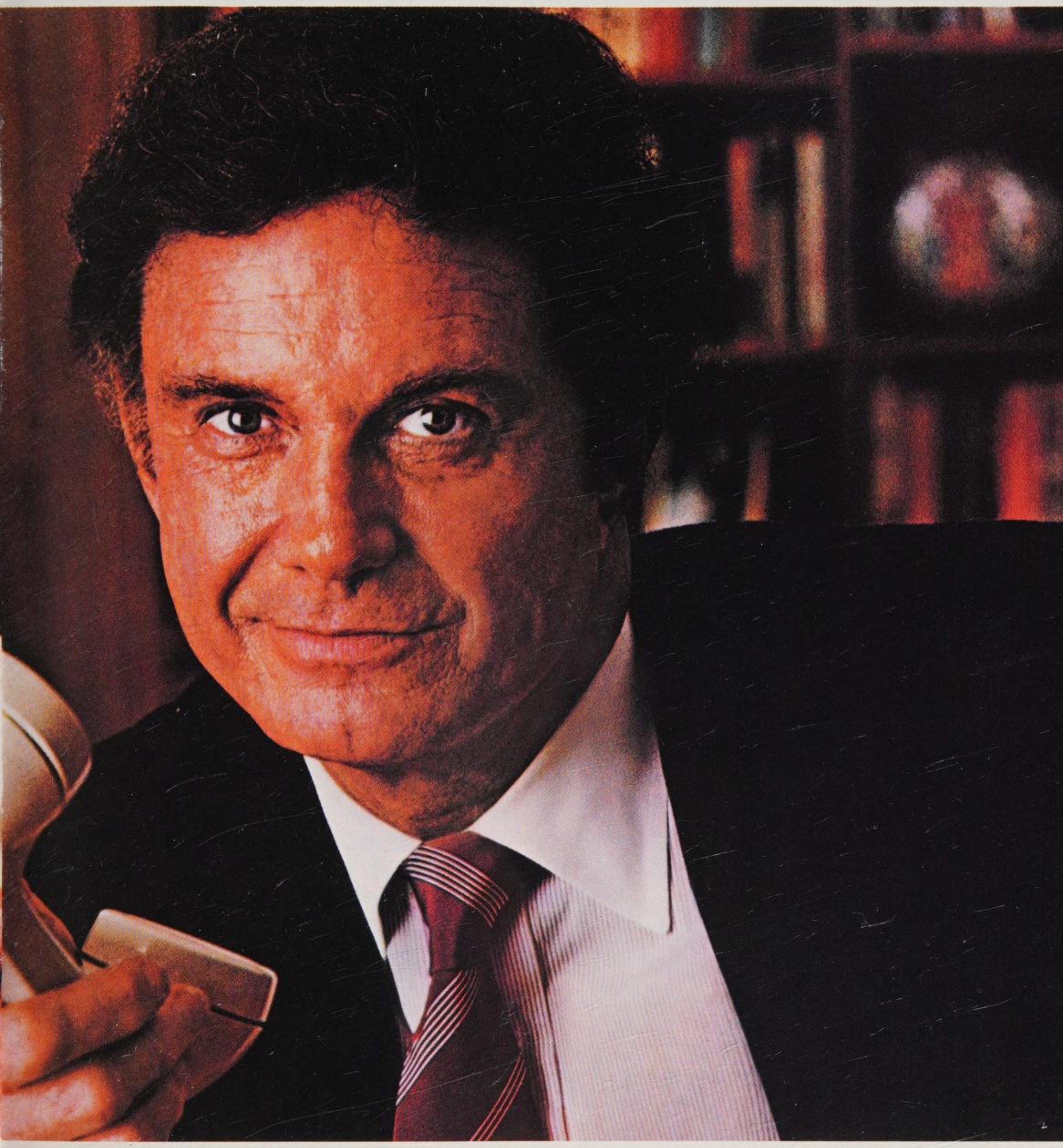

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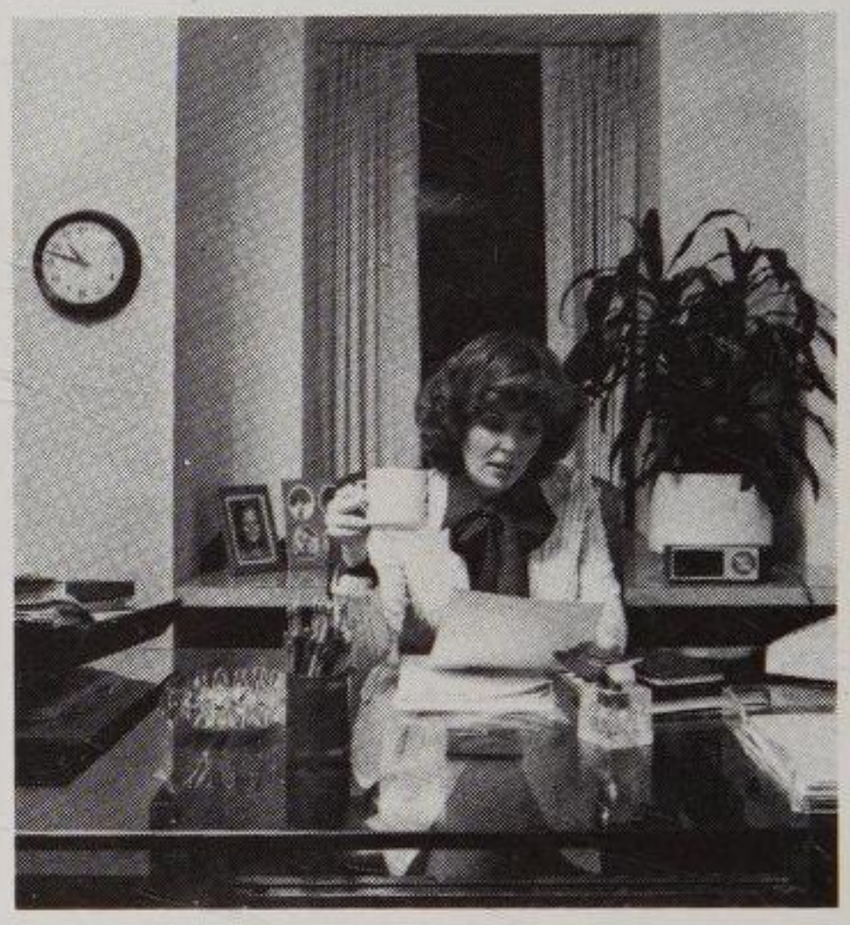
Heart attack or stroke could knock you down on your way up.



You're working for the challenge, the satisfaction, the success. The last thing you want is a heart attack or stroke. Yet nearly one million Americans die of heart disease and stroke every year. And 200,000 of them die before retirement age.

The American Heart Association is fighting to reduce early death and disability from heart disease and stroke with research, professional and public education, and community service programs.

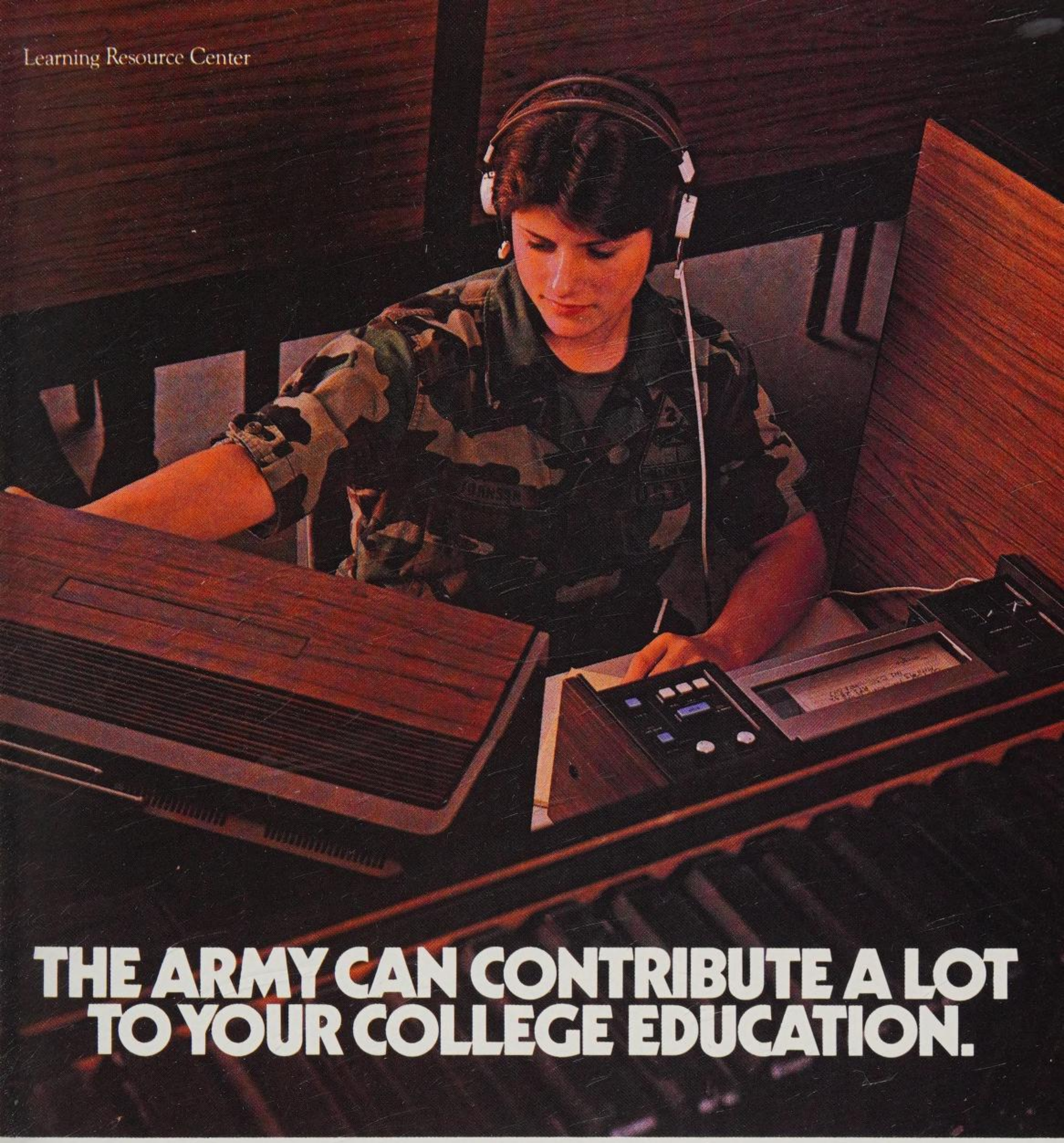
But more needs to be done.

You can help us find the answers by sending your dollars today to your local Heart Association, listed in your telephone directory.

Put your money where your Heart is.

American Heart Association

WE'RE FIGHTING FOR YOUR LIFE



THE ARMY CAN CONTRIBUTE A LOT TO YOUR COLLEGE EDUCATION.

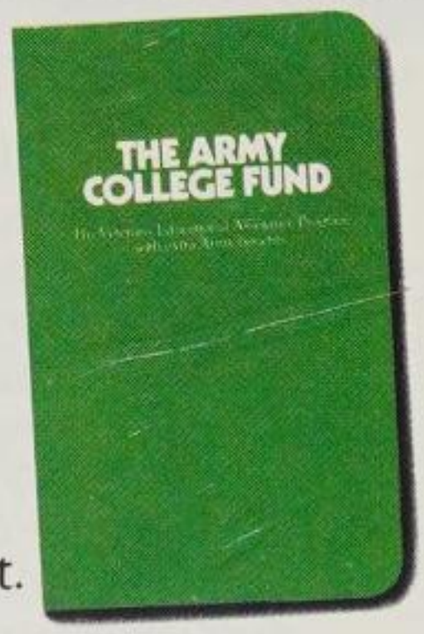
In today's Army, you learn to accept challenge, handle responsibility, and make the most of any given situation. And that's much of what it takes to be a good college student.

So if you're planning to attend college, maybe you should think about how spending some time in the Army can help you get there. Not only will you be better prepared to handle the challenge, you can also be better prepared to handle the costs. By taking advantage of the Army College Fund.

In just three years, if you qualify, you can accumulate as much as $20,100 for college costs. (In two years, you can accumulate $15,200.)

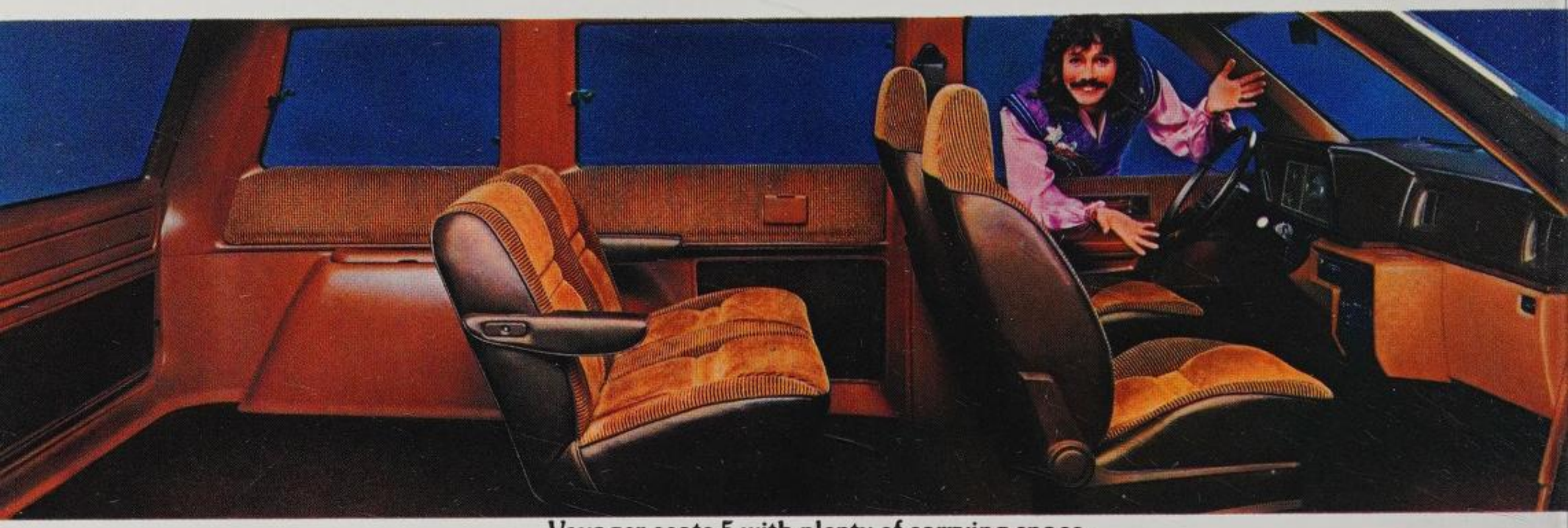
The Army College Fund works like a savings plan. For every $1 you save from your Army salary, the government adds $5 or more.

Call toll free 1-800-USA-ARMY for your free Army College Fund booklet. And find out how the Army can contribute to a very worthwhile cause—your college education.



ARMY.
BE ALL YOU CAN BE.

Plymouth Voyager. The Magic Wagon.



Voyager seats 5 with plenty of carrying space.

Or, would you believe, an option for 7.

With 2 passengers, Voyager has more carrying space than a big conventional wagon: 125 cubic feet.

Plymouth Voyager: America's most versatile wagon.

Suddenly a wagon that gives you big wagon space and lots of passenger room doesn't have to be a big wagon. Or clunky or hard to maneuver or expensive to run. Not if it's the new Plymouth Voyager, The Magic Wagon. It's three feet shorter outside than a big conventional station wagon, yet gives you even more carrying space inside, 40 percent more, up to 125 cubic feet.

Voyager has room for two or five passengers or, would you believe, an option for seven. Voyager is a front-wheel drive wagon with rack and pinion steering. It handles like a car in town and over the road, parks just as simply and easily fits in your garage. Altogether, The New Chrysler Technology has created versatility GM, Ford and most of the imports haven't matched.

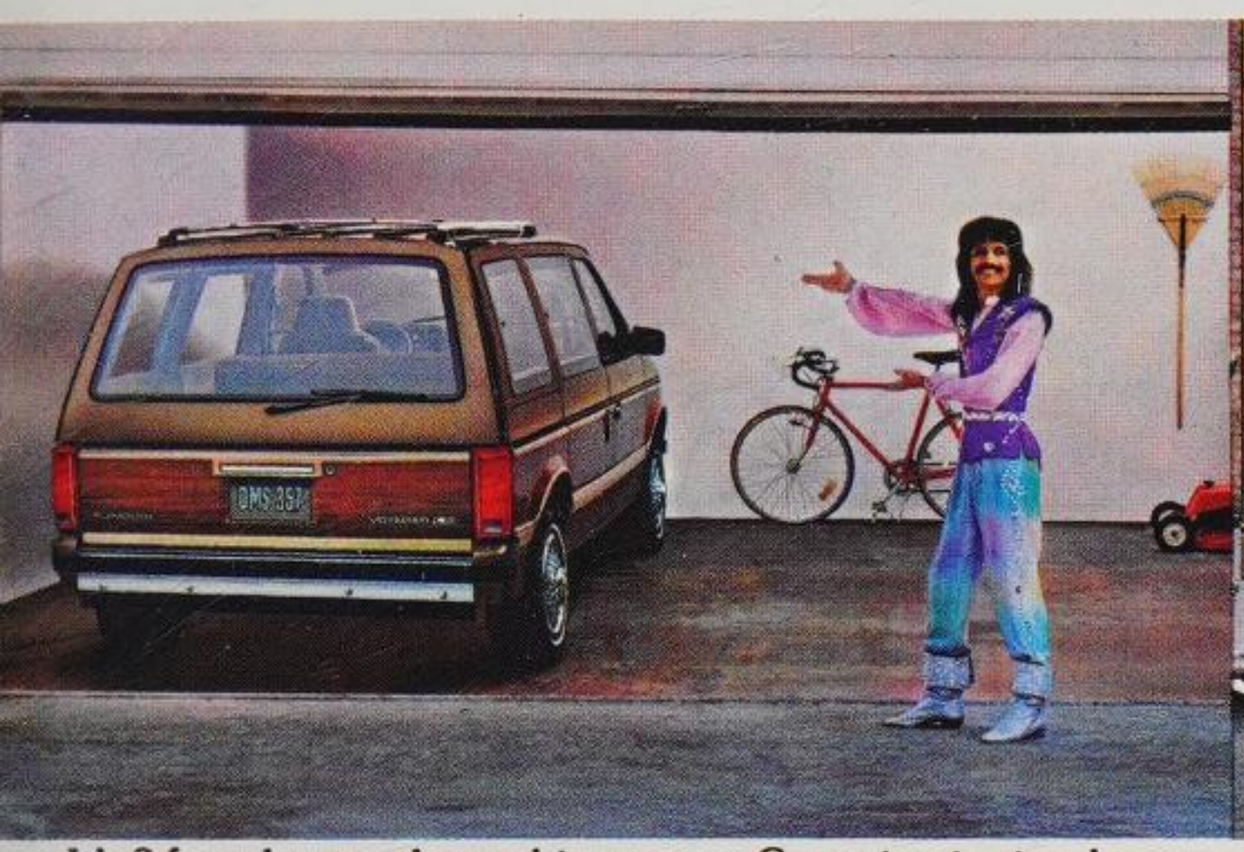
Would you believe? 37 EST. HWY. **24** EPA EST. MPG*

A little magic goes a long way.

If you've filled up recently you've noticed gas prices still aren't exactly what you'd call cheap. So it's reassuring to know that Voyager's gas mileage is incredible. Young,

*Use EPA est. mpg for comparison. Mileage may vary depending on speed, weather and trip length. Actual hwy. and Ca. ests. lower. destination charges. •Lowest percentage of recalls based on National Highway Traffic

You've got to drive it to believe it.



It's 3 feet shorter than a big wagon. Garaging is simple.

With rack and pinion steering, it parks like magic.

Voyager is designed for easy, graceful entrances and exits.

Front-wheel drive keeps it going through snow and wet spots.

The Ins and Outs of Voyager are unbelievably versatile.

Would you believe it handles like a car? Believe it!

growing families will appreciate the versatility and economy of America's Magic Wagon.

Would you believe a 5 year or 50,000 mile Protection Plan?**

It's easy to believe in Magic when it's protected for 5 years or 50,000 miles. Plymouth backs every Voyager that long: engine, complete powertrain and against outer body rust-through. No extra cost to you. No other wagon is protected like that. Magic that lasts.

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Plymouth

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Our #1 crippling disease:
The pain of arthritis is shared by over 30 million Americans. One in seven is afflicted with this debilitating and sometimes disabling disease. And arthritis is not limited only to the elderly. Even children can suffer from it.

What is arthritis?
The word *arthritis* means inflammation of the joint. Swelling, redness, and especially *pain* are present in nearly all cases. While arthritis rarely poses a threat to life, it can often cause disability.

Of the over 100 forms of arthritis, the two most common are:
Osteoarthritis—The most common type of arthritis, usually associated with advanced age. Osteoarthritis limits the movement of joints, calling for changes in one's normal activities.
Rheumatoid arthritis—Often beginning between 40 and 50 years of age, rheumatoid arthritis can be the most debilitating type of arthritis. It is not only limited to joints, but may also affect other organ systems (lungs, muscles, skin, nervous system, even the heart).

Both forms of arthritis are more prevalent in women than in men. Their causes are at present unknown.

Symptoms of arthritis:
Early morning stiffness or aches, difficulty in movement or bending, and swelling and/or tenderness in one or more joints are all symptoms of arthritis. The hands, wrists, feet, elbows, knees, and shoulders are often sites of arthritic pain. If you are experiencing these pains, you should seek the advice of your doctor.

Myths and quackery—
they can hurt more than help.
The days of "copper bracelet" and "exotic herb" cures are, unfortunately, not over. These and other "miracle" treatments *cannot* cure arthritis. They often do result in a loss of money and a delay in proper medical care.

Your best defense is to see your doctor.
Arthritis patients can benefit greatly from proper treatment. The sooner you bring symptoms to the attention of your doctor, the sooner you can begin to correctly manage your arthritis. Your physician can use a range of advanced therapies, including new medicines, that can reduce the pain and inconvenience. Today there are drugs which not only are effective, but can also reduce the number of doses previously needed to as few as one per day.

Along with medicines, a tailored program of exercise and rest can be used to strengthen joints and keep them moving smoothly. Your doctor can also instruct you on ways to help yourself at home (hot baths, massage, etc.).

It's important to know that your physician, along with other health professionals, *can* make arthritis easier to live with. They are part of the overall health support system. We call it...

Partners in Healthcare:

You are the most important partner.
Only you can make the decision to see your doctor. It is you who must decide to accept the guidance and counseling of your physician and other healthcare professionals. When medicines are prescribed, only you can take them as directed.

Your doctor interprets the warning signs, orders your tests, and makes the diagnosis.
Along with the proper program of rest and exercise, your physician also prescribes the best medication for you among those available—considering each drug's characteristics—and monitors your progress.

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The longer you use it, the better it can be for your engine.

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21.3% Pineapples
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21.3% Bananas
44.7% Sugar Cane
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100
50
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Quiet Operation	YES (NO FAN)	NO	YES	NO
Memory	128K	128K OPTION	256K	256K OPTION
Graphics Display (640 x 200 resolution)	YES	OPTIONAL	YES	OPTIONAL
Printer Port	YES	OPTIONAL	YES	OPTIONAL
Communication Port	YES	OPTIONAL	YES	YES
MS™-DOS/BASIC®	YES	OPTIONAL	YES	OPTIONAL
System Expansion Slot	YES	YES	YES	YES
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Typical System Price	**$2995**	**$3843**	**$4995**	**$5754**

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What is perhaps most impressive about the TeleVideo IBM PC Compatible can be found deep within its circuitry. We use the same 8088 central processing unit that runs an IBM PC. But we also employ new VLSI (Very Large Scale Integration) microchips that are designed and built exclusively for TeleVideo. These interface more efficiently with the powerful 8088 and yield numerous benefits.

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But the Tele-PC is only one element of the TeleVideo IBM PC Compatible line.

THE BEST PORTABLE FOR THE BEST PRICE.

Features	TPC II	COMPAQ
High Capacity Storage	YES	NO
2nd Disk Drive	YES	OPTIONAL
Quiet Operation (No Fan)	YES	NO
Ergonomic Display	YES	NO
Communication Port	YES	OPTIONAL
International Power Supply	YES	NO
MS™-DOS 2.11	YES	NO
Graphics Display	YES	YES
Typical System Price	**$2995**	**$3710**

The TeleVideo XT is the best hardware for users of popular IBM XT software who would appreciate an extra 10 megabytes of storage capacity along with the advantages listed on the preceding chart.

As the chart above demonstrates, our portable IBM compatible computer, the TPC II, is far and away better hardware than COMPAQ.™ Better hardware — standard — at a better price.

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The TeleVideo IBM PC Compatible line is made by the world leader in multi-user computer systems and the number one independent manufacturer of terminals.

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Before you invest, make a few simple comparisons. You'll find that TeleVideo—not IBM or COMPAQ—has the best hardware for the best software. At the best price.

*Source: PC World, April 1984

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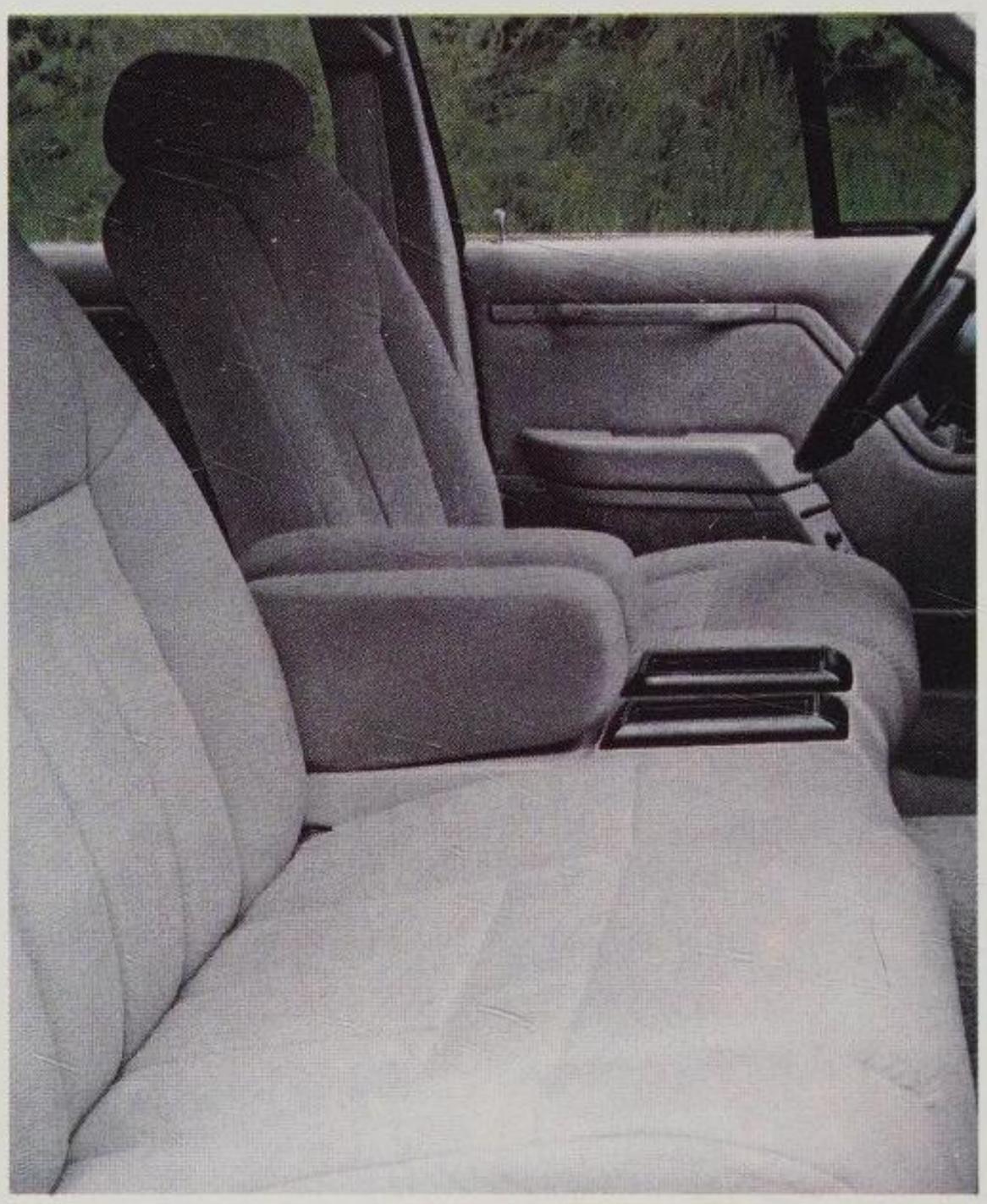

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Have you driven a Ford... lately?

Ford

IN MARCH the Geographic family said farewell to Robert E. Doyle—the most recent past President of the Society. It would be unfair to say that Bob will be missed on a day-to-day basis, because he had been out of the office for some time, fighting a cancer that would give no quarter. What *can* be said—and really should be carved in stone—is that this modest man was a better leader than he ever suspected.

The "Chief" came to the Geographic as a Washington-born Irish boy of 19 with no university degree. If Horatio Alger had not written his books, Bob Doyle could have been the mold for the American success story. He worked his way up from the bottom, with no special privileges beyond his own talent, to become President and Vice Chairman of the Board of Trustees. Working mostly in the business department, he became the leader of an editorial organization without ever having been a part of the editorial staff.

Nearly 50 years with the same organization should have given him a thick skin. Just the opposite. His gentle nature—congenitally unable to fire anybody—sparked a loyalty and continuity among his staff that is legendary. When a party was given in October 1982 for all employees—active or retired—who had more than 25 years of service, more than 300 showed up. During Bob's half century with the Society, 12 people retired with 50 or more years, 47 with more than 40.

Owen Anderson, Executive Vice President, touched a common chord in his eulogy: "I speak as a man who knew him as friend and mentor for 38 years—a long time for never a harsh or unkind word to pass between two people. We admired his great executive talent—a searching mind, the quick recognition of the worth of a new idea, the fair and incisive resolution of problems, the wonderful and catching enthusiasm. We admired him even more because we knew he had two bottom lines, the one on a piece of paper and the one in the human heart."

His legacy to you as members is a highly efficient, computerized membership fulfillment operation that delivers your magazine, books, and other products with a speed and friendly competence that is unparalleled.

Though he was not an editor by title, his integrity and sense of fairness shaped the editorial policy and the quality of the magazine as surely as if he had been.

Wilbur E. Garrett

EDITOR

NATIONAL GEOGRAPHIC

June 1984

By Rail Across India 696

From Pakistan's Khyber Pass to Bangladesh, author Paul Theroux and photographer Steve McCurry travel a monumental rail system, where every day ten million passengers ride six thousand trains on . . .

India's Railway Lifeline 744

Railroad historian Michael G. Satow tells the colorful story of Britain's legacy to her former colony.

Hagi: Where Japan's Revolution Began 751

A remote castle town, home of a remarkable teacher-warrior and his disciples, launched the 19th-century revolution that modernized Japan. By N. Taylor Gregg, with photographs by Sam Abell, paintings by Kinuko Y. Craft, and a special map supplement.

The Ant and Her World 774

Each member of this all-female society knows her job and does it. Caryl P. Haskins introduces the strikingly different . . .

Ways of the Ant 779

Some are hunters and gatherers, weavers, cultivators, and stock breeders. Others are kidnappers, slaveholders, or con artists. Bert Hölldobler describes the most successful of the social insects. Paintings by John D. Dawson, illustrations text by Alice J. Hall.

Eskimo Hunters of the Bering Sea 814

Outboard motors, videotape players, and the prospect of nearby oil drilling have not shaken Eskimo dedication to ancestral traditions, as Brad Reynolds and photographer Don Doll discover in Alaska's Toksook Bay.

COVER: *Belching smoke and steam, an engine rolls past India's Taj Mahal at Agra. Photograph by Steve McCurry.*

THE NATIONAL GEOGRAPHIC MAGAZINE
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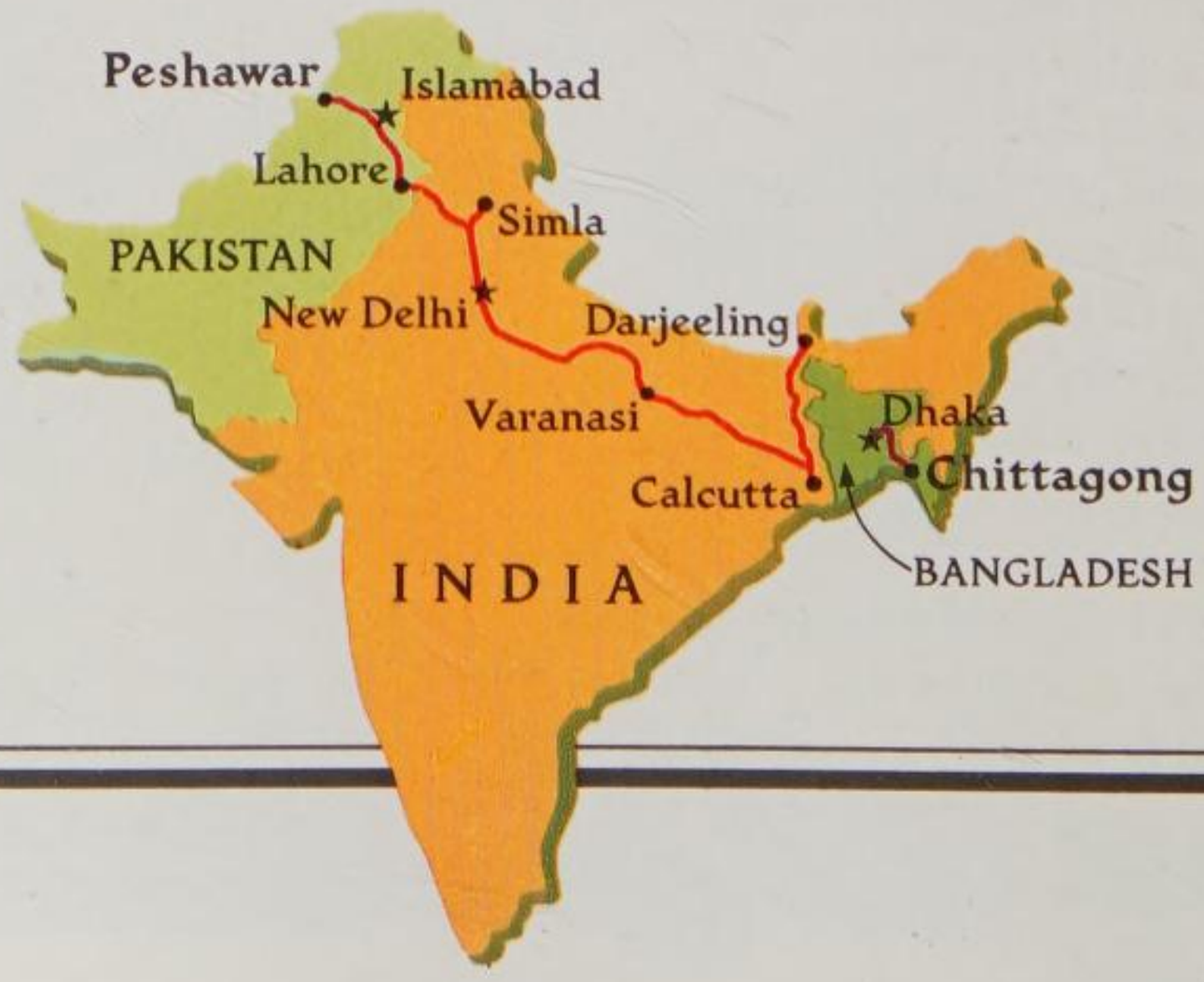
FOUNDED 1888

By Rail Across the Indian Subcontinent

By PAUL THEROUX

Photographs by STEVE McCURRY

BREAKFAST between Peshawar and Lahore is a dizzy adventure for bearers who pass trays between the dining car and first class, where locked inside doors assure security. Inherited from Britain in 1947 and unequaled for presenting a pageant of humanity, an epic rail system takes the author from the Khyber Pass to Bangladesh. He rekindles some memories—warts and all—that helped inspire his best-selling work The Great Railway Bazaar.



It takes a narrow-gauge iron horse to negotiate these Himalayan foothills. It took iron men to blast 103 tunnels through

them for a 4,290-foot (1,308-meter) climb to Simla, elegant resort and cool summer capital during British rule.

Last ride with a pet clouds the face of a farmer's son taking the Varanasi-to-Calcutta train a few miles to market

to sell the goat. The railway is an indispensable fixture of Indian life, carrying 3.7 billion passengers a year.

Into scenes of "temple India" the trains also bring tourists. At Agra Fort station, where a cartop attendant adjusts a ventilator,

they see domes and minarets of the Jama Masjid, a mosque completed in 1648 under Mogul Emperor Shah Jahan.

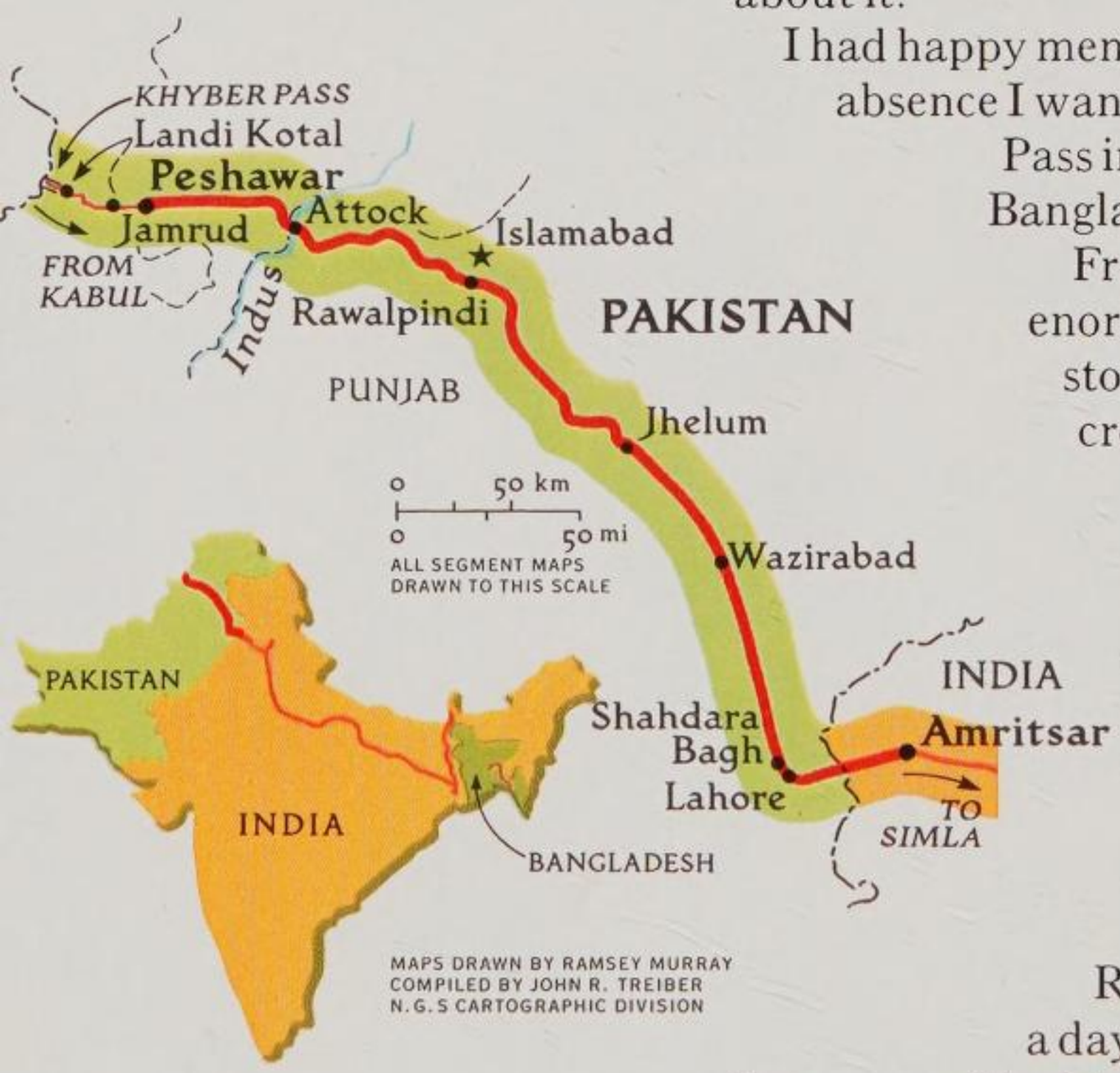
FROM PESHAWAR

INDIA. How does this vast overpopulated subcontinent manage to run, and even to prosper? For 130 years the chief reason has been the railway. Dusty and monumental, its trains often seem as ancient as India itself. In Pakistan they look like part of the landscape. An old reliable network of track brings hope to beleaguered Bangladesh.

Much of Indian life is lived within sight of the tracks or the station, and often next to the tracks, or inside the station. The railway was one of the greatest imperial achievements of the British raj, and now, a larger system than ever in a subcontinent divided into sovereign nations, it still has the powerful atmosphere of empire about it.

I had happy memories of the trains of India, and after a ten-year absence I wanted to return and to trace a line from the Khyber Pass in Pakistan, and through India, to Chittagong in Bangladesh, taking as many trains as possible.

From the corner seat in a railway car I could see an enormous amount of this land: moving east from the stony cliffs of the North-West Frontier in Pakistan, crossing Punjab and the valleys of the Indus, then cutting into India on an express, traveling up and down, linking the hill stations of Simla and Darjeeling with the long straight journeys of the plains—via Delhi, the Taj Mahal, and the holy city of Varanasi on the Ganges. After Calcutta I could nip into Bangladesh to the end of the line (map, page 747).



The statistics associated with Indian Railways are elephantine (ten million passengers a day, 11,000 locomotives, 1.6 million workers), but the memorable details are simple enough: It is self-sufficient in rolling stock—India manufactures all her own coaches and engines—and it makes an operating profit of 12 percent revenue over expenditure. In many respects, India is one of the world's greatest railway nations—in total number of trains, stations, and long-distance travelers; and also in a negative sense, with the most cockroaches, the greatest number of rats living under railway platforms, the most forms to fill out, and some of the dirtiest sleeping cars. In India the railway is not merely a way of going to and from work, but rather a solution to the complex demands of the family's life. Birth, death, marriage, illness, and religious festivals all require witnesses and rituals that imply a journey home.

TO CHITTAGONG

I started in Pakistan, from Jamrud, a deserted station a short distance from Jamrud Fort, which, having been built in 1836, is just ninety years older than the Khyber Railway. It was an early morning in July, and very hot—the monsoon was weeks overdue.

Once a week the Khyber train descends the 3,500 feet from the highest point of the Khyber Pass, carrying the refugees and travelers who can afford the seven-rupee (35-cent) fare. The train is required to climb such steep inclines that it is powered by two steam engines—one at the front and one at the rear of the five coaches—both belching smoke and whistling as they make the journey to and from Landi Kotal.

"Once there was no trouble here," a man told me as we clattered across the plain. "There was no water, no trees. Only small villages. Then a dam was built and water came to the valley in a stream, and since then there has been constant fighting."

Tempers were very bad. Months of drought had scorched the face of the land and made it so hot that people had moved out of their houses and set up their string beds under trees. Men sat on the banks of the trickling stream beside the railway tracks and chatted keeping their feet in the water.

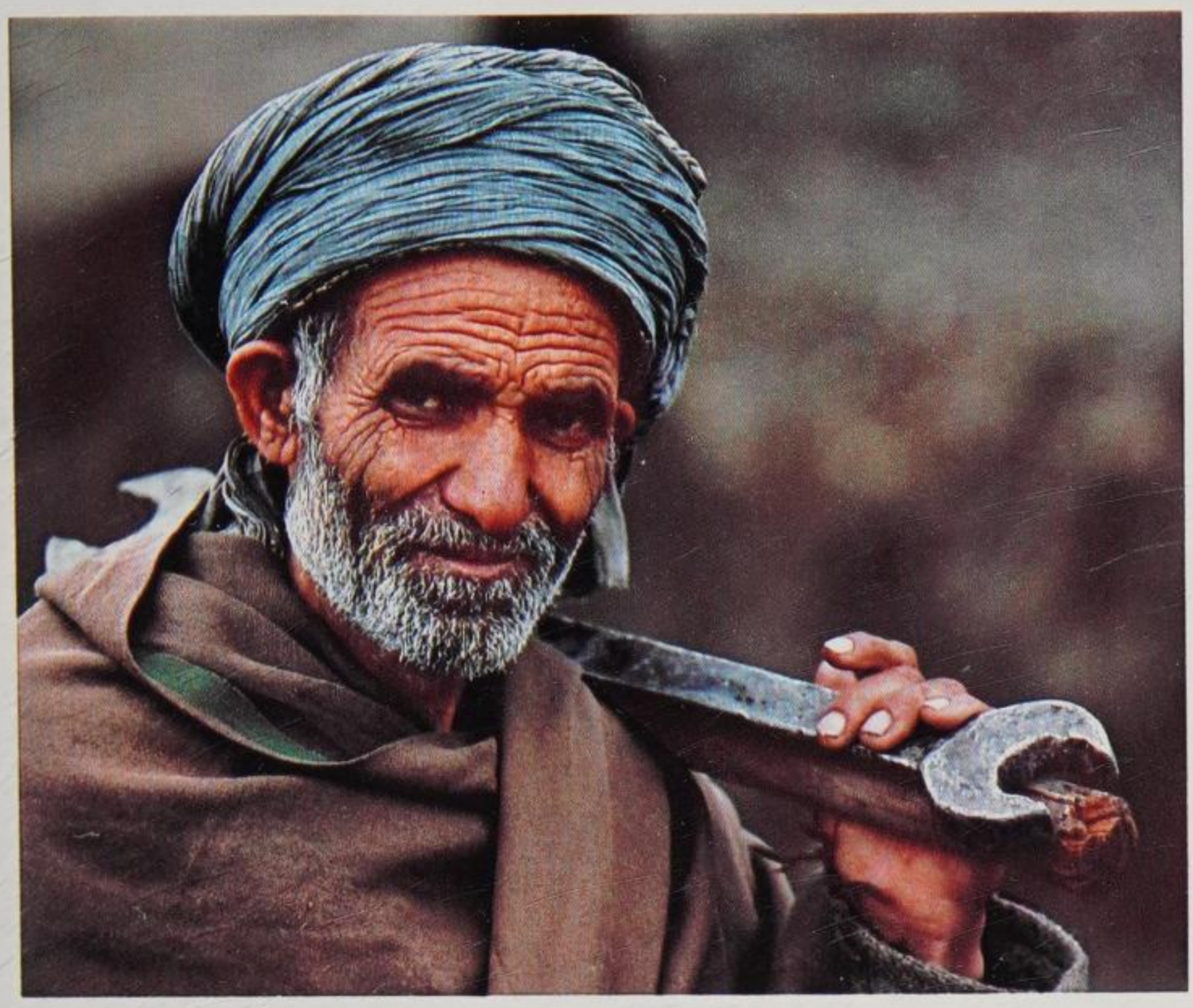
There were more than 35,000 people in the Kacha Garhi refugee camp, and nearly as many in the one at Nasir Bagh not far away. Driven from their homes in Afghanistan by the war, they lay in hammocks, they cooked under trees, they waited for the weekly shipment of food; they watched the train go by. Across ten miles of gravel are the high gray-brown mountains that mark the border of Afghanistan, and the black smoking train makes its way across the dead land.

This was always a tribal area, the people were always dressed like this, and always armed, the train was always pulled by smoking, screeching steam engines, and the nighttime noises were always human voices and the clopping hooves of the tonga ponies, and when—hours late—the train pulls into Peshawar Cantonment station, it is pitch dark and 110°F. Most people make straight for the bazaar.

"This is the Qissa Khawani Bazaar," said Ziarat Gul, a powerfully built and kindly soul who was known in Peshawar as "Gujjar—Buffalo Man." He was pointing at a labyrinth of alleys too narrow for anything larger than pony carts.

"This means the Storytellers' Bazaar. In the old times all the *kafilas* [caravans] came from Persia and Russia and Afghanistan, here to Peshawar. They told stories of their journeys."

Peshawar is once again a great destination. Now the travelers



Famed gorge reverberates *with the music of steam as a train, part of Pakistan's rail legacy from Britain, nears a tunnel in the Khyber Pass (**facing page**). A second engine, out of sight at rear, helps power the train up grades.*

*Near the Afghanistan border a Pathan tribesman (**left**) hefts a wrench used to tighten track bolts. While many Pathans work for the railway, too many of their Afghan kin are passengers fleeing combat between Soviet troops and Afghan fighters. Some three million refugees have sought shelter in Pakistan. Some of the homeless get no farther than the tracks, where refugee camps sprawl in a bleak landscape.*

are Afghan refugees, and the stories in the bazaar concern the heroism of Pathans ambushing Soviet convoys. There are said to be more than three million refugees, and many of them bring goods and food to sell at the bazaar—carpets and jewelry, embroidery, leatherwork, cartridge belts, pistol holders, rifle slings, almonds, dates, prunes, and fresh fruit. The bazaar has never been busier or more full of hawkers. Everywhere are the beaky, craggy faces of the travelers, turbaned men and shrouded women, rifles and pistols, and the tea drinkers huddled around samovars—storytellers again.

I OCCUPIED an air-conditioned compartment on the *Khyber Mail,* and in its grumbling way the machinery actually worked. I was soon traveling under a bright moon through Nowshera and across the Indus River at Attock. We passed through Rawalpindi and Jhelum, too, but by then I was asleep.

Just before Wazirabad at dawn there was a knock on the door of my compartment. "You wanting breakfast?"

I could have been wrong, of course, but it seemed to be the same brisk man who had asked the same question ten years ago: He had the same bad eye, the same dirty turban, the same lined face. And the breakfast was the same as well—eggs, tea, bread on heavy stained crockery.

Scattered showers of the monsoon had begun to appear. They darkened Lahore, once the princely city of Akbar and Shah Jahan, now the capital of Punjab. It was cooler here, and the rice fields had water in them; planting had begun; the grass was green. The soil was mostly clay, and so brickworks had sprung up, each one with a steeple-like chimney. Little girls, fully clothed, some looking as young as six or seven, were digging mud and clay out of pits for bricks and carrying it in baskets on their heads. Meanwhile,

A very careful shave *is what a barber gives his conspicuously armed customer in Pakistan's Peshawar Cantonment station* ***(facing page)****. Superintendent Abbas Ali Shah* ***(above)*** *boasts of the station's cleanliness—"The few that are clean really stand out," agrees photographer McCurry.*

Rail links between India and Pakistan were severed when war broke out in 1965 and remained closed for 11 years. Trade is now brisk, with Indian iron ore and pig iron rolling into Pakistani steel mills.

little boys played in the grass or swam in ditches. It appears the absurd custom of the country to require little girls modestly to remain clothed and do most of the laborious work, while naked boys can frolic all the livelong day.

The decrepitude near Shahdara Bagh was interesting, because not far from Shahdara station is one of Pakistan's most glorious buildings, the Tomb of Jahangir, with its vast park—grander than the Shalimar Gardens—and the marble mausoleum inlaid with gems; all of it in a perfect state of preservation.

WHEN INDIA was partitioned in 1947, so was the railway, but the trains didn't stop running until the 1965 Indo-Pakistani war. For 11 years the steel rails connecting Wagah in Pakistan with Atari, the Indian border town, were silent. And then in 1976 the trains began to run again. Very little had changed on this line; the steam locomotives, like all steam locomotives in India, looked filthy, ancient, and reliable; they are great sooty thunder boxes, and there are 7,245 of them still operating in India. The coaches were battered, and the train was very slow. This was the *International Express*.

The train left on time, which surprised me, considering that the thousand or so people on board had all had their passports stamped and their luggage examined. We traveled across a plain toward India. After an hour every man we passed wore a turban, the symbolic headpiece of the Sikhs. We were nearing Amritsar, spiritual capital of the Sikhs, and as practically all Sikhs are named Singh, we were among the great family of Singhs.

Sikh is from the Sanskrit word *shishya,* meaning "disciple." The Sikhs are disciples of a tradition of ten gurus, beginning with 15th-century Guru Nanak, who taught monotheism, espoused meditation, and opposed the Hindu caste system. On the approaches to Amritsar, Sikhs herded goats, Sikhs dug in the fields, Sikhs processed the passengers on the *International Express*. At Atari station the operation took several hours: everyone ordered off the train, everyone lined up and scrutinized, everyone ordered back on. Then the whistle blew and the black smoke darkened the sky, and we proceeded into India.

But it was not only black smoke in the sky. The clouds were the color of cast iron; they were blue-black and huge. It is usually possible in India to tell whether it will rain from the whiteness of the egrets—they look whitest when rain is due—and these dozens flying up from the paddies near Amritsar were brilliantly white against the dark clouds massing over us.

We arrived just before one o'clock at Amritsar, and as our train pulled in, passing buffaloes and scattering the goats and ducks and children, the storm hit. It was the first rain of the monsoon—pelting gray drops, noisy and powerful and, only minutes after it had begun, already erupting from drains and streaming under the tracks. The rain in its fury put the Indians into a good mood. It was the sunny days and blue skies—intimations of drought—that made them bad tempered.

Because of the rain, only pedicabs were running in Amritsar. Automobiles lay stranded and submerged all over the inundated city. I sat inside, deafened by the rain, and studied the timetable,

EXIT
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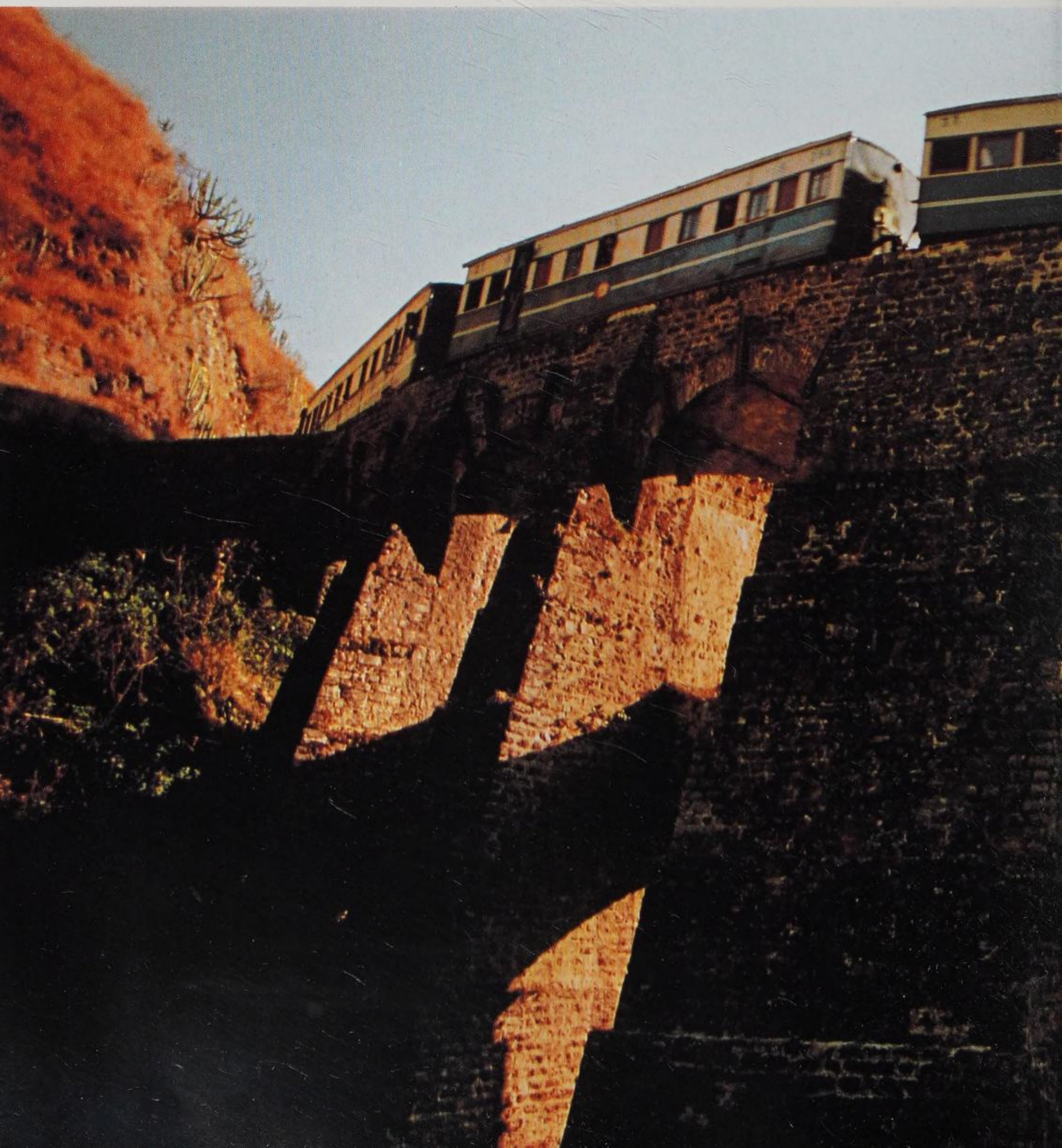
and after a while I became curious about the route of a certain train out of Amritsar. This particular mail train left Amritsar at ten in the evening and headed south on the main line to Delhi; but halfway there it made a hairpin turn at Ambala and raced north to Kalka where, at dawn, it connected with the railcar to Simla. It was an extraordinary route—and a very fast train: Instead of going to bed in the hotel, I could reserve a sleeper, board the train, and more or less wake up in the foothills of the Himalayas, in Simla.

It was not a popular train, this *Simla Mail*. Its odd twisted route was undoubtedly the result of the demands of the imperial postal service, for the British regarded letter writing and mail delivery as one of the distinguishing features of any great civilization. And Indians feel pretty much the same.

My sleeping car was unswept; like a cell, it had barred windows



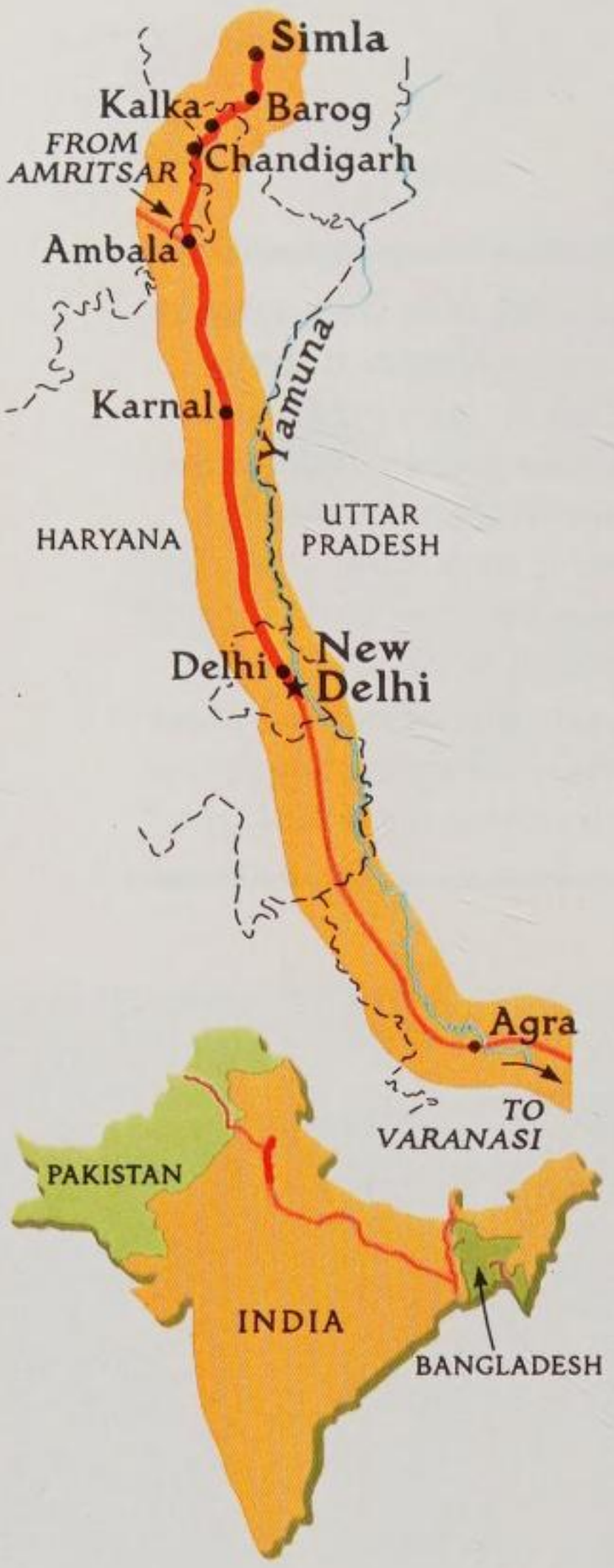
and a steel door. "Use the shutters," the ticket collector said, "and don't leave any small articles lying around."

The whistle of the *Simla Mail* drowned the sounds of music from the bazaar. I was soon asleep. But at midnight I was awakened by rain beating on the shutters. The monsoon that had hit Punjab only the day before had brought another storm, and the train struggled through it. The thick raindrops came down so hard they spattered through the slats and louvers in the shutters and a fine spray soaked the compartment floor.

The guard knocked on the door at 5:20 to announce that we had arrived at Kalka.

It was cool and green at Kalka, and after a shave in the Gentlemen's Waiting Room I was ready for the five-hour journey through the hills to Simla. I could have taken the small pottering *Simla Queen* or the express, but the white 20-seat railcar was already

Favorite side trip, *a train to Simla crosses a tiered masonry-arch bridge as Indians graze cattle below. Prior to train service in 1903 it took eight grueling hours by horse-drawn tonga to reach Simla, adored by Rudyard Kipling as a place "where all things begin and many come to an evil end."*



*"**People's Express**" means lots of people crammed into little space (**facing page**). They are expressly advised to be patient because service often runs hours late. Such Janata trains offer only no-frills second class.*

That India's strength lies in her poor is reflected by her railroad. Even in 1904 nearly 200 million rode lowest class on a system barely half a century old. Today second-class railway earnings outstrip others nearly tenfold, although the humblest fare averages about three-fourths of a cent a mile, among Asia's lowest.

waiting at the platform. I boarded, and snoozed, and woke to see mists lying across the hills and heavy green foliage in the glades beside the line.

Two hours later at 5,000 feet we came to the little station at Barog, where every day the railcar waits while the passengers have breakfast; and then it sets off again into the low tumbling cloud. Occasionally the cloud and mist were broken by a shaft of light, and parted to reveal a valley floor thousands of feet below.

The opinion of the Indian in the hill station is that the plains are disorderly and crime ridden: As soon as people climb above three or four thousand feet, they tend to behave themselves. The train guard at Simla station was full of complaints about lowland vandalism and tardiness and "mischief—especially political mischief" on the railways.

"You're very frank, sir," I said.

"It is because I have resigned," he replied.

The residents of Simla, where once the high officials of the raj and their ladies went to escape the hot season, are often visited by relatives. "They always say, 'I'm coming for two or three days,' but after three weeks they're still here. And there is something about this air that excites them and makes them difficult."

The man speaking was an army colonel. He had a remedy for unwelcome guests. He made lists of sights that were not to be missed in Simla. Each one was a day's walk from his house, and it was usually at the top of a steep hill. After a few days of this sightseeing, the starch was out of his guests, and they were fairly glad when it was time to go.

The most knowledgeable railway buff I met in Simla was a man who, over a period of years, had traveled all over India on trains, visiting racetracks. He seldom stayed overnight. He would hurry to Lucknow on a night train, gamble all day at the track, and then catch the sleeper to Calcutta and do the same thing. I said it seemed a difficult thing to do, all that railroading. No, he said, the difficult thing was putting on a sad face and hailing a tonga and then riding third class so that no potential thief would guess that he had 5,000 rupees of winnings in his pocket.

I GLIDED DOWN from Simla in the cozy little blue train to Kalka and then in the late evening boarded the sleeper for Delhi. It was air-conditioned, and the bed was made—starched sheets and a soft pillow. There was no better way to Delhi. The next morning I looked out the window and saw the outskirts of the city, simmering under the gray lid of the sky.

At Old Delhi station it seemed to me that the unluckiest railwayman in this season of heat was a fireman on a steam locomotive. As I rambled around the station yard, however, I discovered an even more exhausting job: boilermaker. The boilermaker is essentially a welder, but because he must deal with all aspects of the boiler, he is often required to use his welding torch inside the boiler or the firebox.

Today it was 103°F at the Old Delhi loco shed, but Suresh Baboo, a boilermaker, crawled out of a locomotive's firebox to tell me that he was not deterred by a little thing like heat.

He was a railwayman grade two and earned a thousand rupees a

Treated like maharajas, *who once possessed not only these elegant cars but their own private railways, tourists dine in the Palace on Wheels. Pulled by a steam engine*

named the Desert Queen, *the train was restored for six million dollars to earn foreign exchange, often at the princely sum of 1,090 dollars for an eight-day trip.*

month ($100), of which four hundred was his "dearness allowance" ("because in Delhi, food and living are very dear"). Was this enough to live on? Not in Delhi. "We are asking for an increase in the dearness," said Suresh Baboo.

Near New Delhi I found the best organized railway station in India. This was Hazrat Nizamuddin station, just south of the city and a short walk from Humayun's Tomb.

There were flowers and shrubs in pots on the platform, and every day on the orders of the stationmaster, G. L. Suri, ant powder was sprinkled along the walls. Mr. Suri proudly took me on a tour of the station. He hadn't been recommended to me by the Railway Board—I had simply stopped on one of the 180 trains that pass through each day and noticed how unusual it looked. How was it possible to keep a station so clean in the hot season?

Mr. Suri said, "I do my duty—I get satisfaction from it. Sometimes I work 16 hours a day. I do not accept excuses." He nodded and added softly, "And I am very tough."

THE *Madras-Janata Express* passes through Hazrat Nizamuddin station without stopping, which is odd, because "janata" means "people" and the "People's Express" stops everywhere. It is probably the slowest express in the world. It would be several days before this long rumbling steam train arrived in Madras. It was cheap, but it was not really meant for long-distance passengers; it went 1,400 miles, stopping at virtually every station—just like a country bus—and most people only went a few miles.

In India it is easy to tell the long-distance travelers. They are heavily laden and always carry a big steel trunk. At railway stations in India one sees the family grouped around the trunk—they sit on it, sleep beside it, use it for a table, and when their train draws in, they hire a skinny man to wrestle it on board.

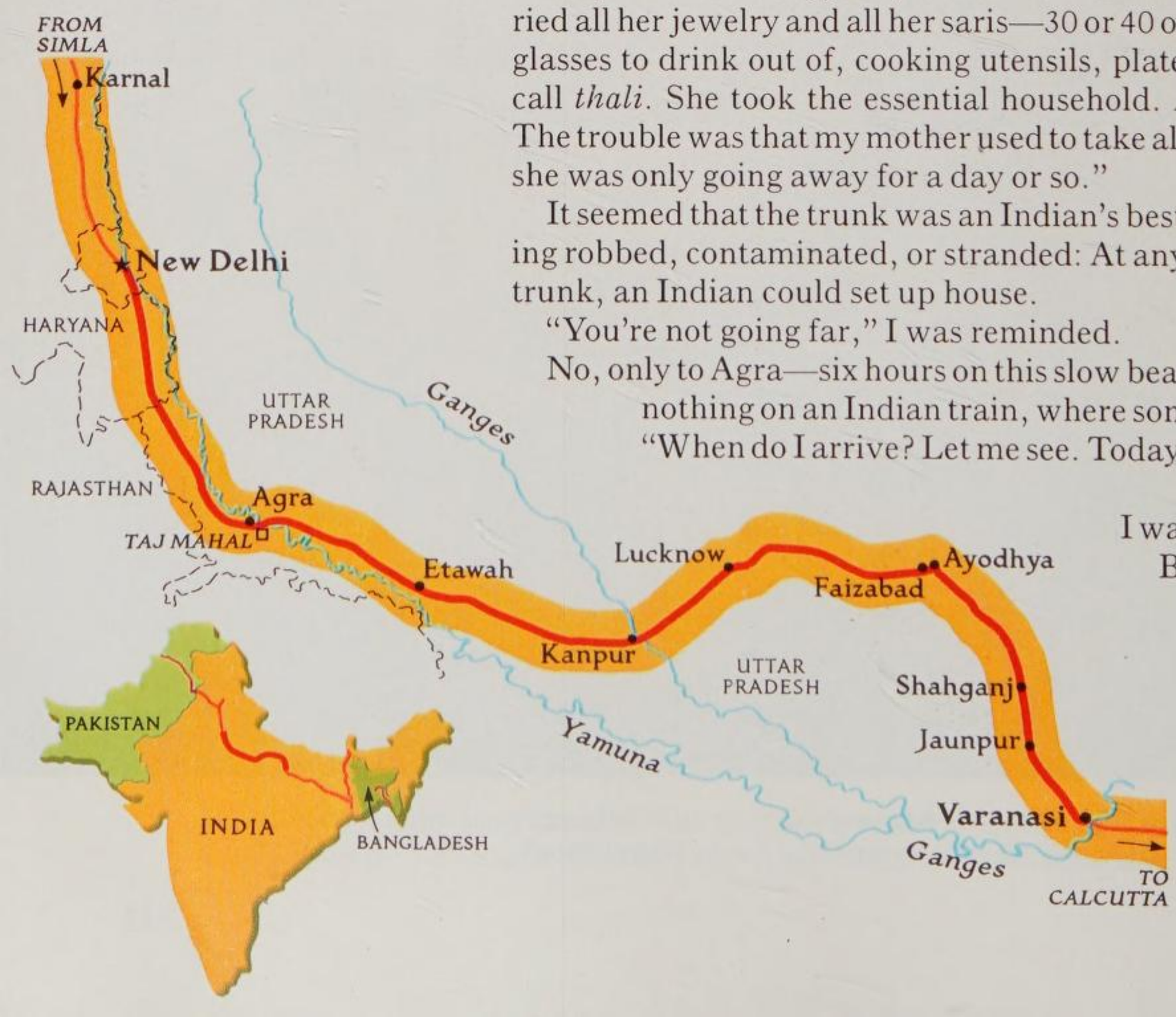
"My mother was typical," a man told me on this train. "She carried all her jewelry and all her saris—30 or 40 of them. She brought glasses to drink out of, cooking utensils, plates, and the trays we call *thali*. She took the essential household. All Indians do this. The trouble was that my mother used to take all these things even if she was only going away for a day or so."

It seemed that the trunk was an Indian's best defense against being robbed, contaminated, or stranded: At any moment, using the trunk, an Indian could set up house.

"You're not going far," I was reminded.

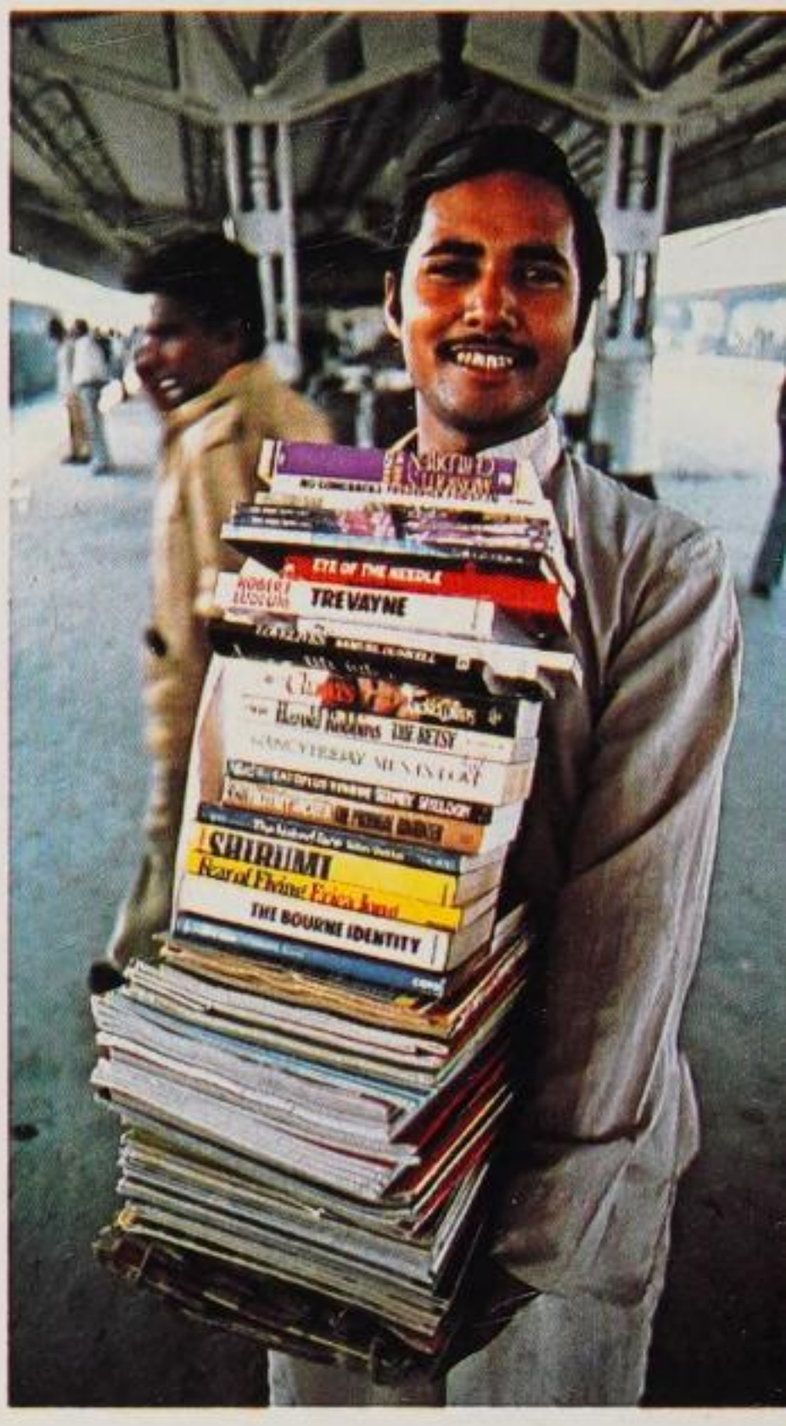
No, only to Agra—six hours on this slow beast; but six hours was nothing on an Indian train, where some people might say, "When do I arrive? Let me see. Today is Thursday and tomorrow is. . . ."

I was sitting across from Bansilal Bajaj, one of the great number of Indians who work abroad. Mr. Bajaj was on home leave from Abu Dhabi. Every two years he got



two months' leave, and he spent a month of that on Indian trains, going up and down the country. "In Abu Dhabi all we do is work," said Mr. Bajaj. "I am in the catering and cleaning business, but I am no more than a machine. When I come back to India, I am human again."

It was a lovely evening, very clear, just after a heavy rainstorm of the monsoon. Now there was not a cloud in the sky, and in the west it was the color of a tropical sea—greeny blue, reflected in perfectly still pools and paddy fields. There was a sweetness in the air and for a number of miles no people—just color and empty space and darting birds.



Bearing any burden, *corps of vendors haunt the stations. In New Delhi a porter balances the luggage of first-class travelers to Agra (**left**). Licensed by Indian Railways and identified by red jackets and brass tags, porters usually sell their services for the equivalent of 20 cents a bag. For readers a bookseller (**above**) hawks a pile of current titles. Vendors offer food and trinkets of every kind, including the great Indian status symbol, sunglasses.*

A deep breath *helps one survive in New Delhi, as second-class passengers cram themselves and their belongings onto the Assam Mail (**right**). Of such competition, photographer McCurry found, advantage can be taken. "As a train nears a station," he says, "a group of guys will jump on and take the seats of passengers getting ready to leave the train. Then the guys auction the seats off to the new passengers getting on." Failure to get a seat can mean standing for eight hours or more. Resting up for her journey, a woman awaits her train near New Delhi (**facing page**). But such hardships of second class appear outweighed by rewards—the ability to commute, to worship, and to join family in myriad celebrations.*

Just after dark the lights in the train failed, and we traveled clattering through pitch-blackness, with the steam engine puffing and wheezing and the whistle blowing off-key. Sparks from the smokestack sailed past the window like fireflies.

It was almost nine by the time we arrived in Agra. The town is nothing. The Agra Fort is substantial. Akbar's Mausoleum at nearby Sikandra has character, and the Moti Masjid (the Pearl Mosque) has personality; but the Taj Mahal is something else. Just looking at it, you are certain that you will never forget it. It is not merely a visual experience, but an emotional one—its pure symmetry imparts such strong feeling; and it is a spiritual experience, too, for the Taj Mahal is alone among buildings I have seen. It is not merely lovely; it looks as if it has a soul.

ON THE *Ganga-Yamuna Express* to Varanasi, it was a long night. There was no bedding, no food, no water; hot cinders blew in the window; even first class was filthy. Dawn broke at Kanpur, and two hours later at Lucknow it was very sunny and bright, a noontime heat, though it was hardly half past seven in the morning.

All the paddy fields were brim full. The rains were dangerously strong in Hardwar and had flooded Delhi, but here beside the line of the *Ganga-Yamuna Express* they had guaranteed a great rice crop and had given the landscape a serene lithographed look—the palms very still, the buffaloes obedient, the Indians up to their shins in water. An emblematic mother carrying her infant weeded vegetables in the middle of another field under the shade of a big black umbrella.

For miles, for hours—for days on these plains—you see nothing else at this time of year; men, women, and children planting or

plowing or tending the crop, and all of them working under the blazing sun and burned as black as their buffaloes.

The villages were mud huts and grass roofs, like a glimpse of central Africa in the state of Uttar Pradesh, except that in the center of every frail village was always a substantial stone temple. None of these villages were signposted, but sometimes a tiny station or a halt displayed the name. We were going the long way to Varanasi, taking the "Faizabad Loop," via Ayodhya, where monkeys on the platform sat on the inkblots of shade. At Shahganj, rice planters stood scanning the blue sky for clouds.

VARANASI STATION has the contours of a Hindu temple, and like a temple it is filled with holy men and pilgrims. It is also full of sacred cows. The cows at Varanasi station are wise to the place—they get water at the drinking fountains, food near the refreshment stalls, shelter along the platforms, and exercise beside the tracks; they also know how to use the crossover bridges and climb up and down the steepest stairs. "We are installing cow-catchers," the station superintendent told me—but he did not mean the traditional ones, on the engines; he meant fences to prevent the cows from entering the station.

Varanasi, for Hindus, is a most holy place to die, or failing that, to be cremated beside the river. Also, Buddha preached his first sermon nearby; the Jains, too, have their own reasons for revering Varanasi. It is the goal of many pilgrimages. Here the beggars are testing the piety of the pilgrims; and those small narrow bundles that are being carried through the streets are in fact human corpses, headed for the cremation fires on the ghats.

Because nothing that is holy in India can be regarded as dirty, holy Varanasi with its thousand temples is one of the filthiest of Indian cities and positively stinking with sanctity. I met an Indian medical student who had just arrived in Varanasi. He was on his way to the Ganges to take his ritual bath. He said he was definitely planning to bathe in the Ganges, among dead goats and monkeys and the occasional corpse of a beggar who died at the station and was taken to the river and thrown in.

"Oh, yes," the medical student said. "I will immerse myself."

"What about the health aspect?"

He said, "It is a question of mind over matter."

That was not the only contradiction I saw in Varanasi. Nailed to a wall that was smeared with betel juice was the sign SPITTING IN PUBLIC IS INJURIOUS TO HEALTH.

Timeless scene *in a time of change. Men and women wash their clothes by the Yamuna River as a train thunders toward Agra on a double-decked bridge carrying a roadway below.*

For railroad buffs India remains a land of bliss because steam engines still account for nearly two-thirds of its fleet. But now they work the short hauls, while diesel and electric locomotives carry more than 80 percent of both freight and passenger traffic.

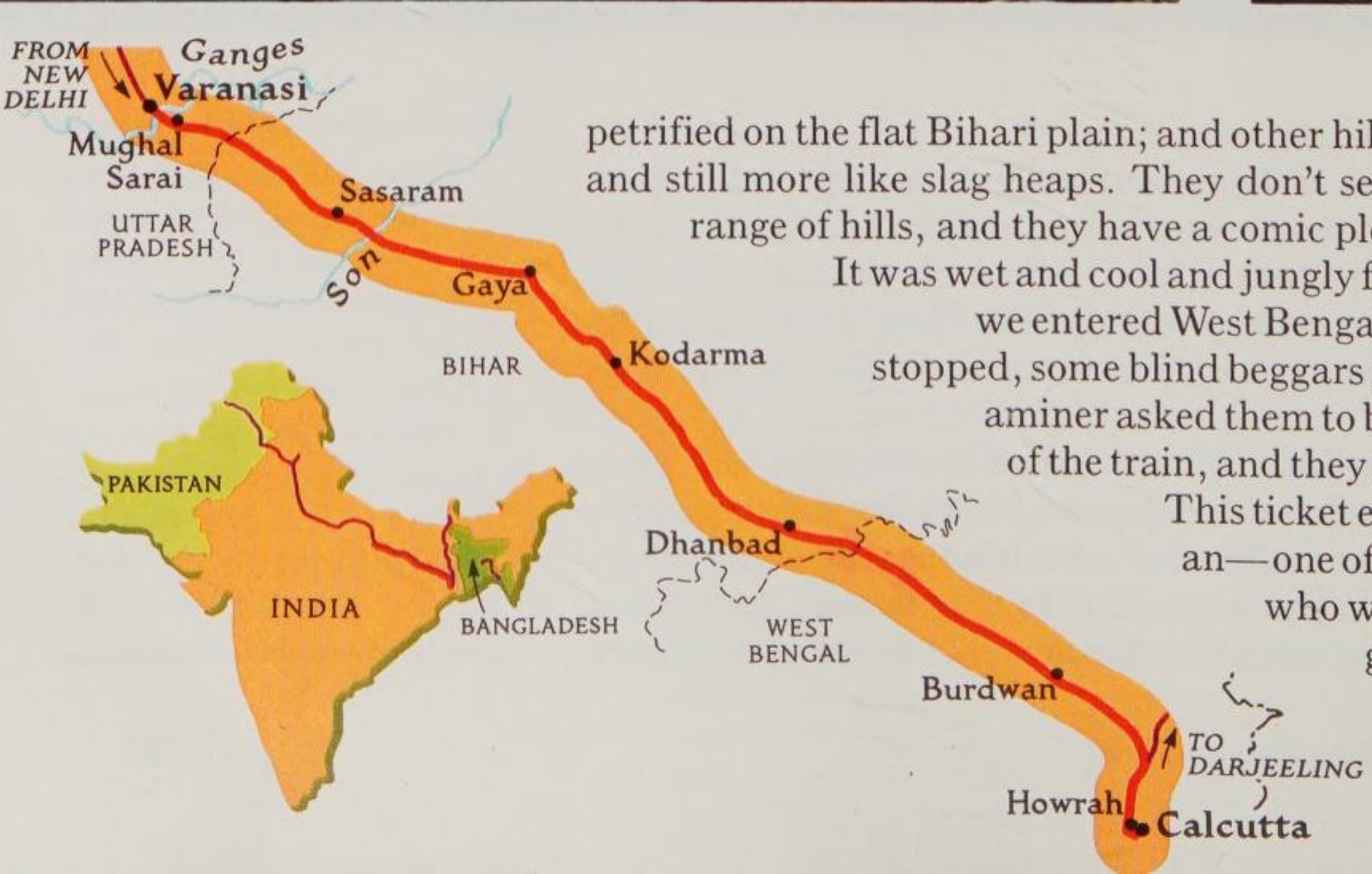
One-man parade, *a line inspector pushed by his retinue rolls past Agra's Taj Mahal during a check for wear and tear on the rails. While serious derailments are rare, mishaps caused by overcrowding—hanging out windows, riding the roof—are all too common on urban lines.*

From a distance in the early morning Varanasi looks wonderful, and the most glorious sight of it is from the express to Howrah as it crosses the Dufferin Bridge that spans the Ganges just east of the city. From the high vantage point of the bridge, the whole populous riverbank and all the ghats can be seen gilded in the light of the rising sun, and the city's splendor is intensified because the distance hides its decay, and at this time of day—the early morning—the river is filled with the pious, washing, swimming, and generally going about their prayers.

The Howrah express, one of India's best trains, leaves Varanasi at 5:30 in the morning, just as the passengers from Delhi are yawning and peering out the windows and getting their first glimpses of

the holy city. And the people waiting on the platform at Varanasi are watching the train with admiration, because this train represents luxury—it has three chair cars, and sleeping cars, and a pantry car, where food is cooked and dished up in trays that are distributed around the train by waiters. The Howrah express is efficiently air-conditioned; it is famous for being fast, and it is practically always on time.

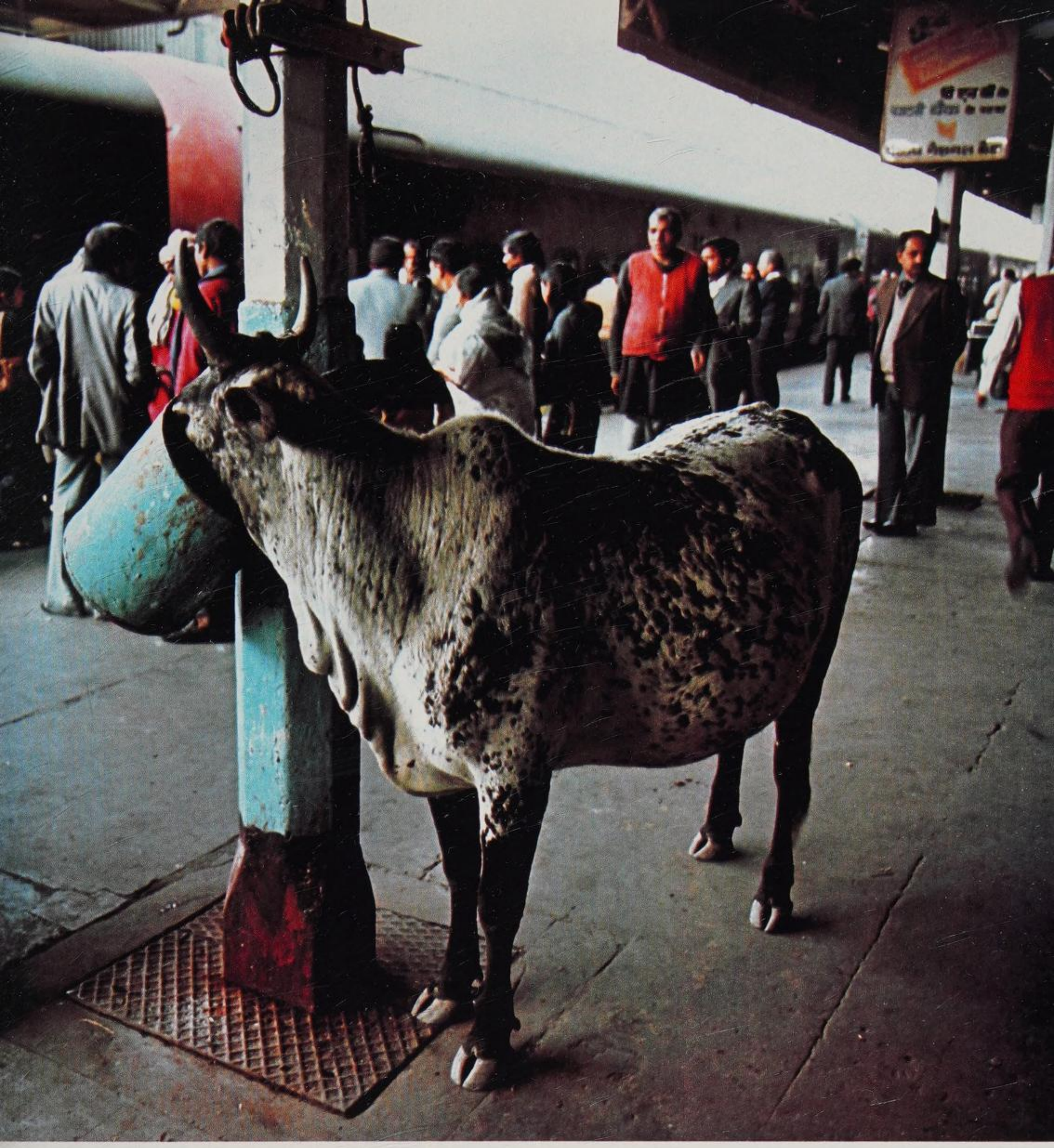
From here—the outskirts of Varanasi all the way to Calcutta—the land is waterlogged and fertile, an endless rice field. At noon the train stops at Gaya, near where Buddha received enlightenment. Gaya also marks the beginning of a very strange landscape. Sudden hills are thrust out of the flatness like massive dinosaurs



petrified on the flat Bihari plain; and other hills are like pyramids, and still more like slag heaps. They don't seem to belong to any range of hills, and they have a comic plopped-down look.

It was wet and cool and jungly four hours later when we entered West Bengal, and when the train stopped, some blind beggars got on. The ticket examiner asked them to beg in a different part of the train, and they meekly agreed.

This ticket examiner was a woman—one of three or four women who work on the train. Her given name was Ollie

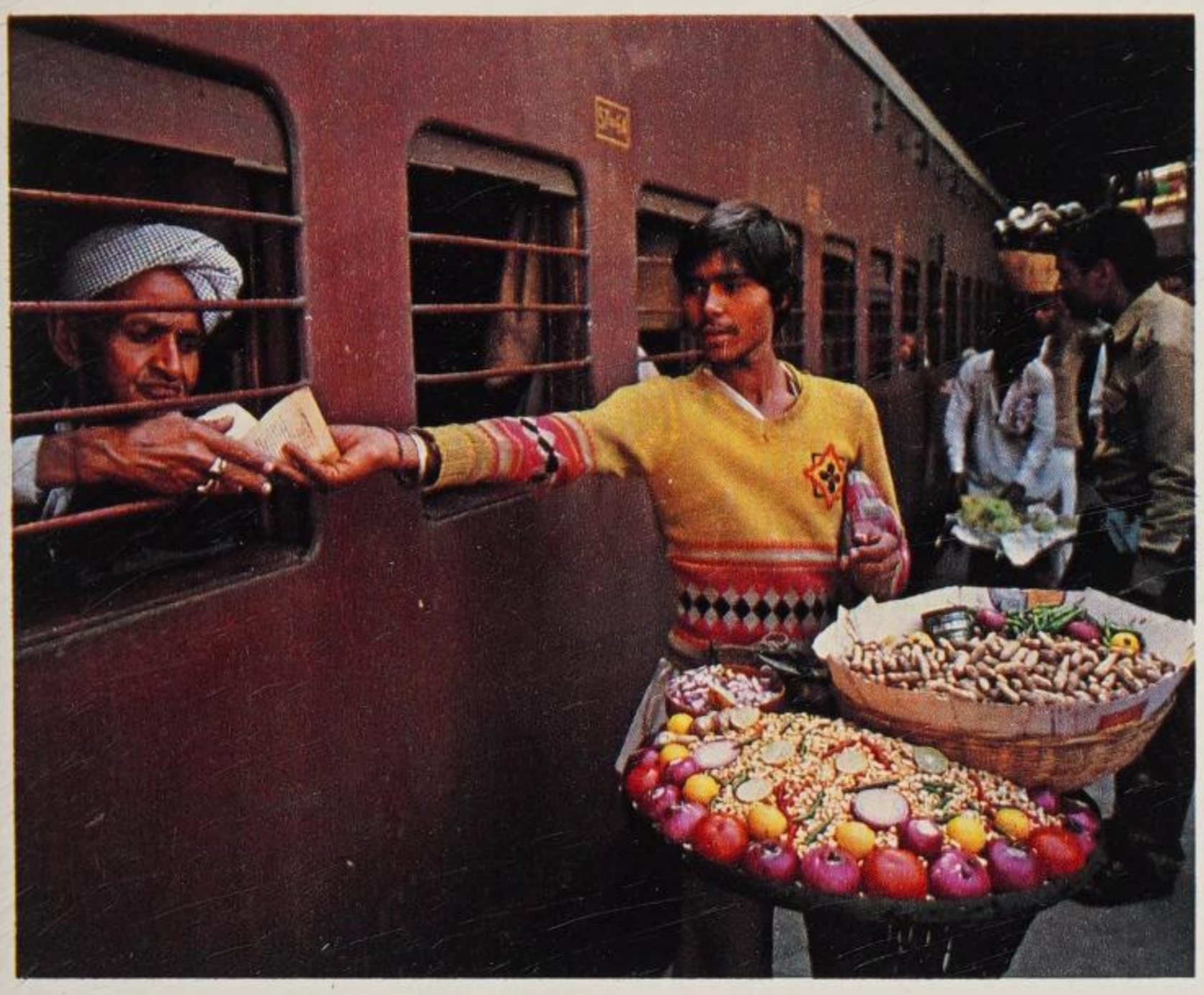


Frances. "I was a Christian," she said. "But then I married Mr. Ningam for love, and so I became a Hindu. It was for the children's sake; it would have been too confusing for them otherwise."

Mrs. Ningam had seven children, the eldest eighteen, the youngest five. She missed them when she made this Calcutta run, but her relatives helped look after them. She had worked for the railways for 20 years.

What Mrs. Ningam liked best about the Howrah express was its speed—less than 14 hours from Varanasi to Calcutta. As the train drew into Howrah station, the daylight was extinguished by smoke and rain mixed with fog; frightening numbers of people were making their way through the mud and lamplight.

On a real milk run, *villagers riding to market between Varanasi and Calcutta hang bulky cans of milk outside the train* ***(facing page)****, thus avoiding delay in wrestling them on and off. In Kanpur station a cow's sanctity gives it free rummage in the trash* ***(above)****.*



Meals on wheels *bring an offer of peanuts, grain, and vegetables from a vendor* ***(left)****, who serves them on pages from old school notebooks discarded and thus recycled. At the holy city of Ayodhya, pilgrims share snacks with pampered monkeys* ***(below)****, associated with the Hindu god Hanuman.*

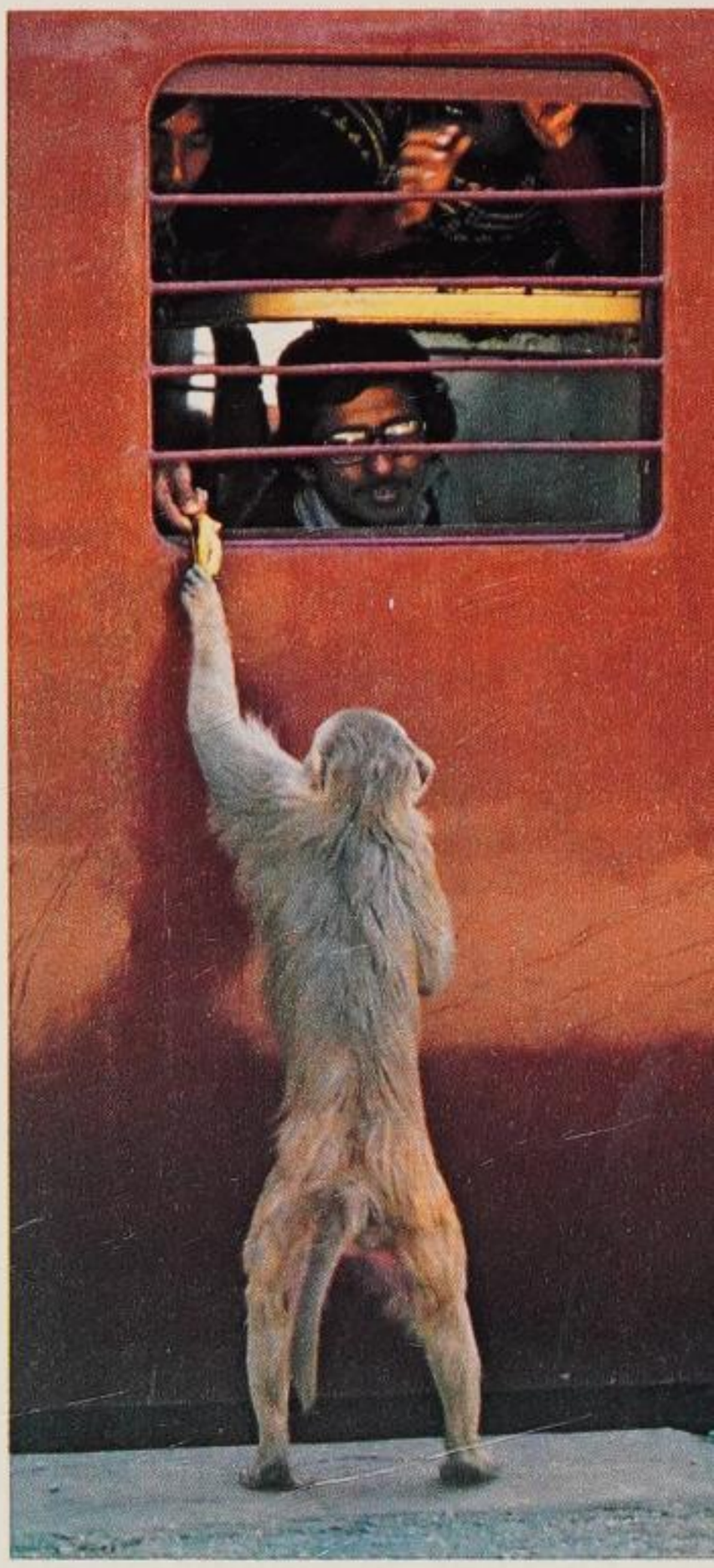
Richer fare is addressed by a cook on a luxury train ***(facing page)****, the* Great Indian Rover, *whose club car is often used for meditation by Japanese touring famous Buddhist sites.*

Howrah station is very large, but like Calcutta it is in a state of decay. Enormous and noisy, a combination of grandeur and desolation, the wonder is that it still works at all. Calcutta is one of the cities of the world that I associate with bad dreams of the future. This is how New York City could look, I think, after some terrible disaster.

The monsoon that beautifies and enriches the countryside made Calcutta ugly and almost uninhabitable. Rain in India gives all buildings, especially modern ones, a look of senility. The streets were flooded, there were stalled cars everywhere, and people waded among the drowned dogs.

"Under prevailing conditions, Calcutta's future is very dark," Professor Chatterjee told me in Calcutta one afternoon. Professor Chatterjee is an astrologer. He then told me (after a brief examination of my palm) that I would live to the age of 78, have another child (a daughter), and be given problems by people of small size.

In Calcutta I reflected on my traveling across the subcontinent by train, my going from station to station. The stations had everything—not only food and retiring rooms and human company, but also each station possessed the unique character of its city, its peculiar stinks and perfumes.



I HAD WANTED to take a train to the state of Assam, to Nowgong and Silchar, and then west to Sylhet and deeper into Bangladesh. But this had become impossible. There was fighting in Assam, civil strife between Assamese and Bengalis, and furthermore the Nagas had never been completely pacified. Even Darjeeling is regarded as a sensitive border area; foreign overland travelers need a special permit to visit Darjeeling, and when the permit is shown at the railway station in New Jalpaiguri, your passport is stamped, just as it would be if you were crossing from one country into another.

In India there is nothing remarkable about a train that is slow—particularly one that is making a long journey through such remote states. But in one respect the *Kamrup Express* to New Jalpaiguri was unusual: It had a dining car. For hours after we left, relays of men—only men—sat in the dining car squashing rice and *dhal* (lentil sauce) in their fists and flinging it into their mouths. Meanwhile, the kitchen staff boiled caldrons of lentils and crouched between the cars strenuously peeling potatoes.

At dawn everything was different and serene. The landscape was dry here, but the trees were green, and not far away were the dim blue shapes of mountains to the north and northwest. We were scheduled to arrive at 7:15. At 7:30 we stopped at a tiny station near the village of Dhumdanj, which was no more than a few cows and a few families and one buffalo.

Two hours passed. This is an aspect of train travel that must not be overlooked: the unexplained stop in the middle of nowhere; and the unexplained delay—hours during which only a dog barks, and someone shuts off a radio, and a child emerges from the tall grass beside the track to sell tea in disposable clay cups. You don't know whether you will leave in two minutes or two days, so it is unwise to stray very far from the train. The sun moves higher in the sky. A child begins to weep. Then an unexplained whistle sounds, and a few seconds later the train moves, and five hundred Indians run beside, trying to board. We left Dhumdanj.

Everyone calls the train from New Jalpaiguri to Darjeeling the "toy train." It is a narrow-gauge mountain railway, with the sort of small blue steam engines that other people put into transport museums; each is a real jewel, a true original. It was bravely built, and it looks so clever and powerful that it seems an impertinence to do anything to it except ride it and let it run. Throughout the hundred or so years in which it has been running, it has hardly been improved. It actually looks indestructible.

Comfort costs. *Traveling from Varanasi to Calcutta, a family enjoys a homemade lunch in their air-conditioned two-level sleeper; seat backs fold down for beds. The adult fare to go 250 miles (402 kilometers) in this semiprivate class roughly equals $11; for air-conditioned chair car, $6; second class (mail/express), which makes fewer stops, $2.65; second class (ordinary), $1.95. And a top-of-the-line totally private air-conditioned two- or four-berth compartment goes for $21.20, in India about the same as taking a plane.*

On this railway line dogs sleep between the tracks, and children play on the tracks and roll toys along them, and the tracks are also put to practical use by men who push huge logs along them—skidding them downhill on the rails.

The four coaches are nearly always full, if not with legitimate travelers then with joyriders—the train is part of the life of the long series of mountainsides en route to Darjeeling. Some people only ride a hundred yards, others are going miles. The toy train is full of businessmen, farmers, Buddhist monks, and schoolchildren. Every ticket is made out in duplicate, though none of them costs more than a few cents.

The train passes by the houses, a few familiar inches from the windows. A boy reaches out and plucks a flower from the embankment covered with blue hydrangeas, yellow primroses, carnations, and roses, and hands it to a woman in a shop.

The valleys and these hillsides are open to the distant plains, and so the traveler on the toy train has a view that seems almost unnatural, it is so dramatic. At Sonada it is like standing at the heights of a gigantic outdoor amphitheater and looking down and seeing the plains and the rivers, roads and crops printed upon it and flattened by the yellow heat. There are wisps and whorls of cloud down there too. But up here it is dark green, wet hill country. Nearly everyone has rosy cheeks.

AFTER SONADA we came to Jor Bungalow station and then to Ghum, the highest railway station on the subcontinent at 7,407 feet. The mist shifts slightly, and farther along, toward Darjeeling, it is possible on a clear day to see the long irregular ridge of Kanchenjunga, massively white in the great folds of snow-covered rock.

The so-called Batasia Loop is the famous descent in which the train appears to be tying itself into a knot while at the same time whistling impatiently to clear its own caboose out of the way. After two complete spirals the train continues on its way, gliding into Darjeeling, still following the main road and bumping past the shops and sharing the thoroughfare with the Buddhist monks and the bullock carts.

Darjeeling, also a famous hill station, is unlike Simla. It is not an Indian resort but rather a Nepalese town. It is a solemn place, full of schools and convents and monasteries. It is barer than Simla, not as populous; it is muddier, friendlier, rather un-Indian in aspect. Simla has visitors, Darjeeling has residents; Simla is Anglo-Indian, but Darjeeling is Oriental. It is not posh. Darjeeling is a hospitable place.

The curse of the town is its traffic—an endless procession of honking jeeps and trucks. It seemed to me that Darjeeling's traffic problem could be solved with an updated version of the railway, which was completed a hundred years ago. The train was a great solution then, and it still serves the town, for many people commute from places like Ghum to jobs in Darjeeling—to the shops, to the government offices, and even to the stranger occupations in Darjeeling such as the carver of yak bones and the clerk who stands under the sign Licensed Vendor for Ganja & Bhang. Ten grams of ganja (marijuana)—30 cents.

The train badly needs to be improved, but of course the wonder of it—like the wonder of much else in India—is that it still operates. India is a complex place. The phones seldom work, the mail is unreliable, the electricity is subject to sudden stoppages. There are numerous natural disasters, and there are 700 million people. It seems almost inconceivable that this country is still viable, and yet there are times when one gets glimpses of its greatness. Near the end of my Indian journey I decided that India runs primarily because of the railway. It is an old-fashioned solution, but India has old-fashioned problems.

INDIA'S relations with Bangladesh could not be described as warm; perhaps on the theory propounded by Robert Frost that good fences make good neighbors, India has recently announced its plan to secure its national boundary with Bangladesh with a 1,500-mile barbed-wire fence.

Passenger trains have not crossed the border for some time. I flew to Dhaka (Dacca) and took the *Ulka Express* east and south toward Chittagong. The *Ulka Express,* 15 coaches long—one was first class—was pulled by a diesel engine. I would have gone second class, but I would not have gotten a seat, and I was not prepared to stand for nine hours.

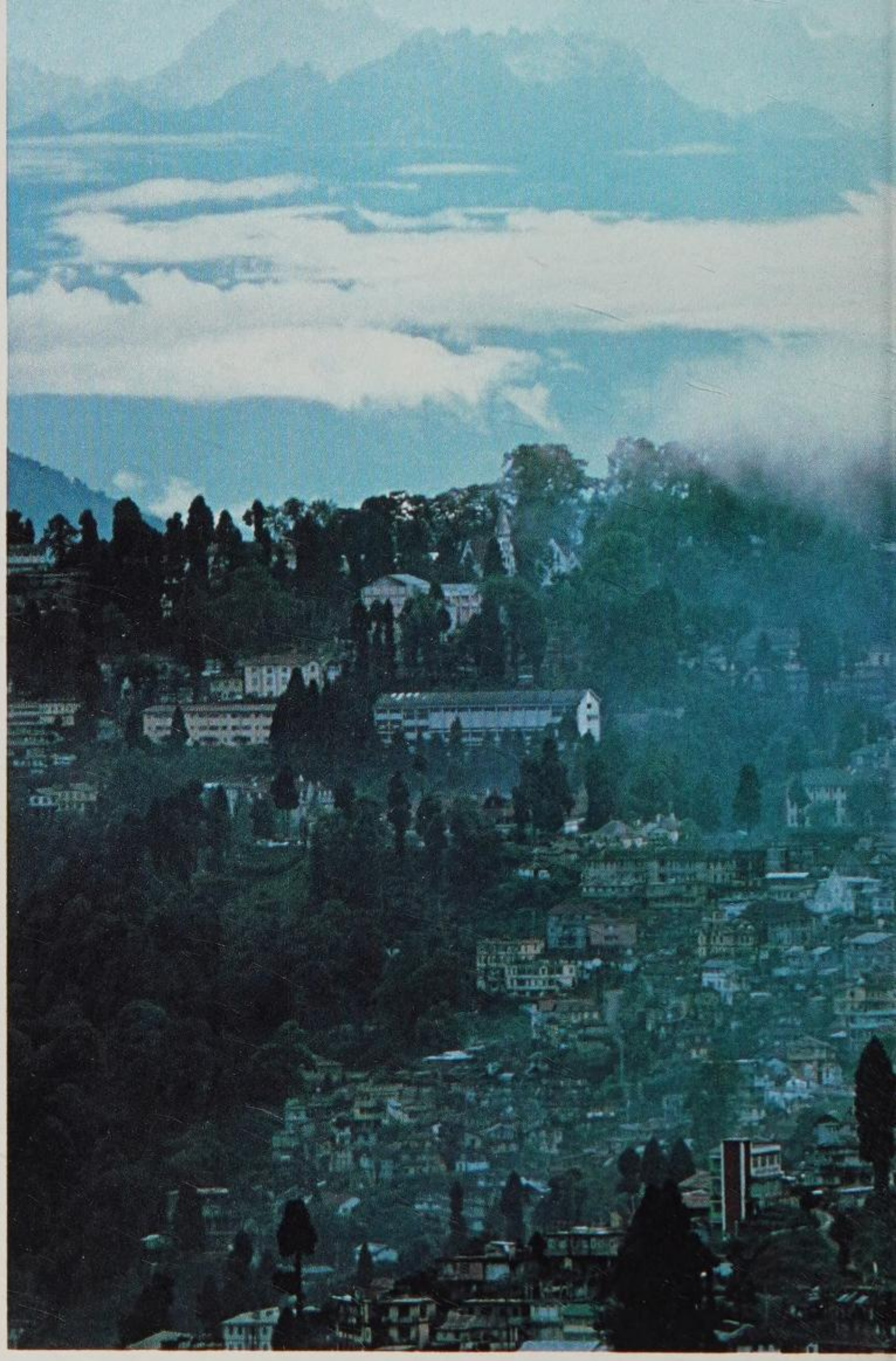
This train was on the world news the day I boarded it: It was the only link between Dhaka and Chittagong. Every other road was under five feet of water, and scores of people had drowned in the torrential rains. But the monsoon comes every year to Bangladesh, and it is always severe. Its damage comes so regularly it is not remarkable. The feeling on the *Ulka Express* was that Bangladesh was having another unlucky week. It was not immediately obvious that the rain was a disaster. Today the sun was shining, and this whole southern part of Bangladesh had been turned into a spectacular lake—hundreds of miles of floodwater. And the only things showing above all that water were the long straight rails of the track.

BOOKING WINDOW OPENS ONE HOUR BEFORE THE ARRIVAL OF EACH TRAIN & CLOSES 5 MINUTES BEFORE IT'S DEPARTURE.
TICKETLESS TRAVEL IS SOCIAL EVIL

Moral strictures *trumpeted in stations* ***(right)*** *do little to deter that wily and ubiquitous Indian species, the fare dodger. Last year a two-week crackdown caught 90,000 passengers without tickets, prosecuted 10,000, jailed 5,000, and recouped millions of rupees in lost revenue. But on a branch line to Calcutta, farmers see nothing wrong with grabbing a free ride to take their hay a short distance to market* ***(facing page)****.*

Portrait of the depot as village, *Howrah station serves Calcutta and embraces a community. The sleepy sprawl anywhere, beggars beg, mothers suckle infants.*

Some vendors live here permanently. Enthusiastic travelers may arrive three days early and camp out. Howrah, India's largest passenger terminal, has seen all.



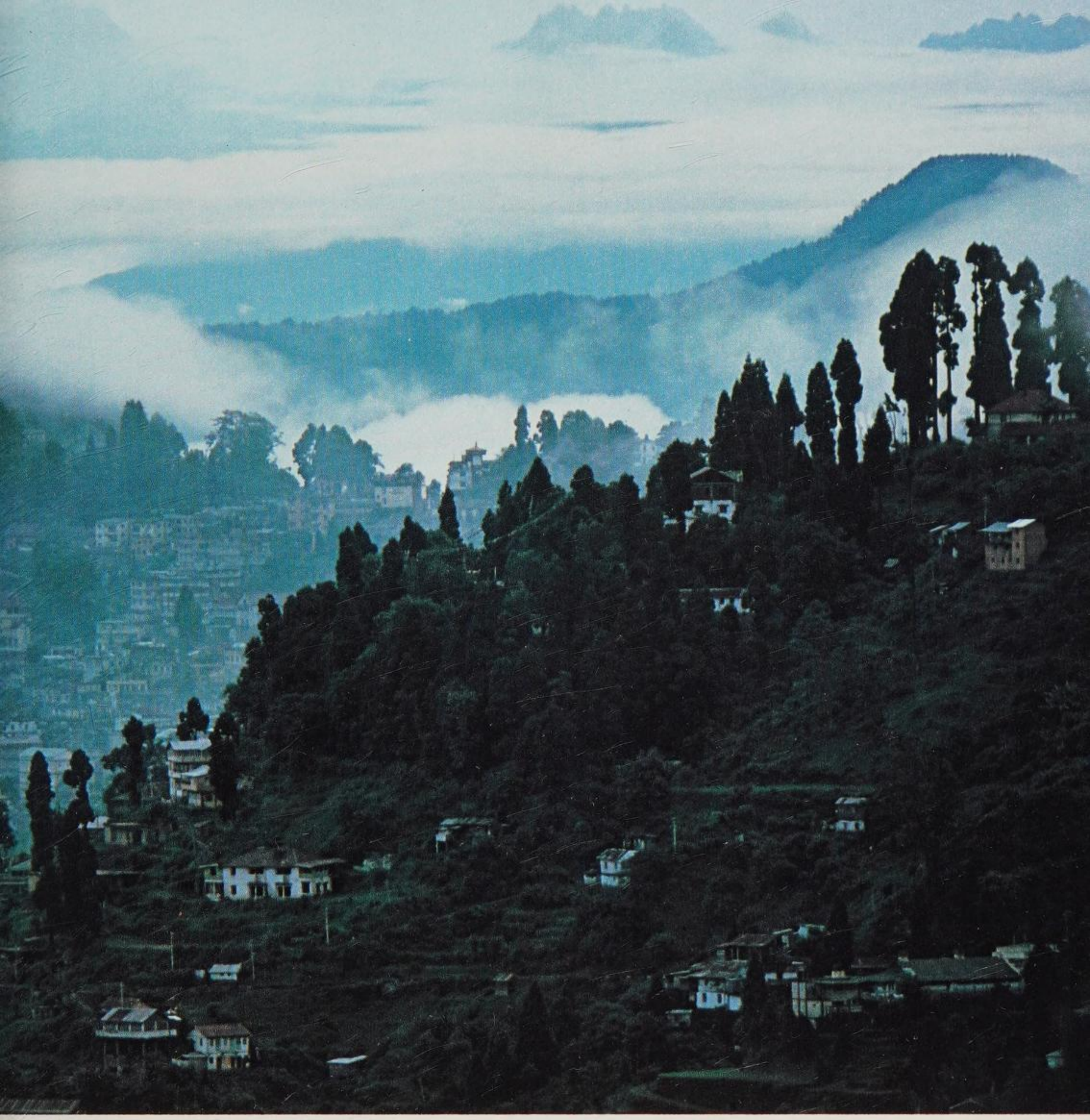
"So wild and interesting and exciting and enchanting that it ought to take a week," declared Mark Twain in 1896 of his eight-hour trip on a narrow-gauge train from Siliguri to the cool heights of Darjeeling. Beyond the mist said to be a boon for one of the town's attractions—plantations of tea—looms another, Kanchenjunga, at 28,208 feet (8,598 meters) earth's third highest peak.

Begun as a sanatorium for the disease-riddled East India Company, Darjeeling was reached by rails in 1881. It still features innovations such as the "Batasia Loop," born of a lofty and ticklish terrain. High above the town, the train executes a steep spiraling descent—as Twain put it, "Like a snake swallowing itself."

At Tongi junction I saw another train pull in. There were perhaps 50 people clinging to the sides of the engine and hanging from the carriages and sitting and standing on the coach roofs. These seemingly magnetized people had the effect of making the train look small. They completely covered it, and of course the paying passengers were jammed inside.

I leaned out the window and saw that, apart from my coach, my whole train was exactly the same—people everywhere, holding on to the sides, the engine, and crowding the roofs. To the sound of a young beggar boy's flute, the train rattled south.

In this hot, stricken country the only things that moved were the trains. But there was no panic. At Akhaura ("Change here for Sylhet") a man stood up to his waist in a flooded field thoughtfully washing his cow, and farther on boats had penetrated to villages—the larger boats were beamy, like old Portuguese frigates, and the



smaller ones were gracefully shaped, much like Persian slippers.

"You will see where President Zia was assassinated in Chittagong," Mr. Shahid said as we rolled along, as if he were passing on a piece of tourist information.

At Comilla I met a young man who had just opened an office to encourage Bangladeshis to enroll in a voluntary sterilization program. "They need incentives. . . ." What sort? I wondered. "We have tried money and clothes as a sort of reward, but it is not enough. We need something more substantial. There is no problem with middle-class people. I have two children myself, and I think that is a good number. The problem is with the poor. But this is a democratic country, and so we do not make sterilization compulsory."

Was he making any progress?

"Very slow progress," he said. *(Continued on page 742)*

Darjeeling's "toy train," *loved by children of all ages (**facing page**), chugs up a grade on track set only two feet apart, narrowest in India. Attendants riding the engine sprinkle sand on wet rails for better traction. Carrying more than tourists, cars echo with Bengali, Hindi, Tibetan, and Nepali. This ethnic diversity is attested by Nepalese schoolgirls (**right**), whose male comrades hitch rides on the train. Tracks lead to market for youths who haul firewood they cut nearby (**above**).*

Too much of a good thing, *monsoon floods drive Bangladeshis to the only high ground. Once part of India's network, the railway was partitioned in 1947 along*

with East Pakistan, now Bangladesh. Passenger service has been suspended for nearly 20 years by strained relations and sporadic border violence.

Sole sign of life, *with every road underwater, Bangladesh Railways carries on* ***(left)****. Amid such severe inundation entire villages will take refuge and camp on the tracks. In Dhaka (Dacca), pedicabs roll through part of the rail yard* ***(below)****. For each train leaving Dhaka, three arrive from the port of Chittagong —ratio of the country's exports to imports.* 741

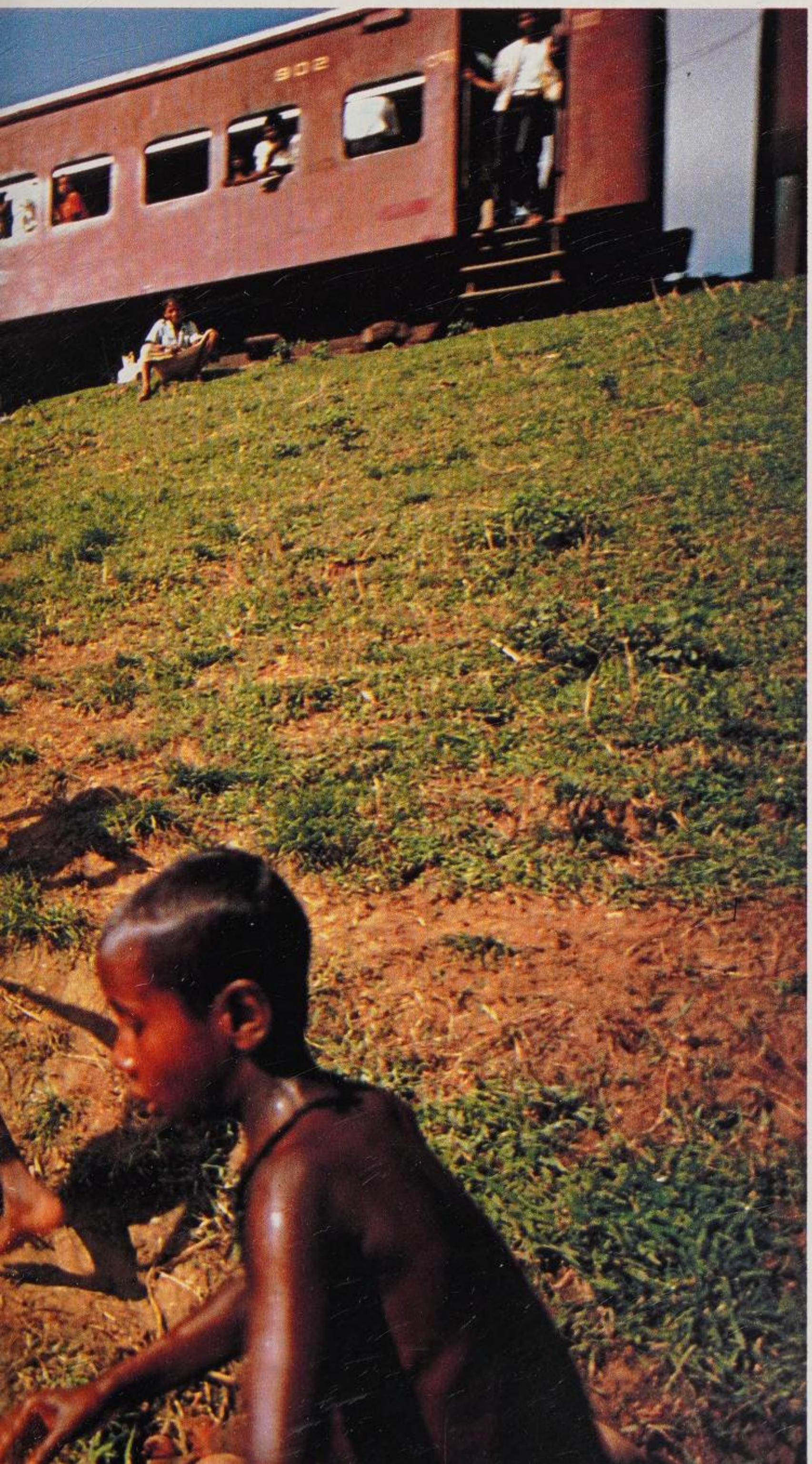
THE WORST of the floods were south of Comilla, at the town of Feni. With a kind of gloomy resignation some people resolutely bailed out their houses and fields, and others took baths. The children in the area were swimming and diving and having a wonderful time. The floods had also brought fish to these hungry people, and where the banks of rivers had been breached, fishermen were enthusiastically using nets, scoops, lines, buckets, and ancient-looking fish traps.

The day continued hot, but the flood did not abate. Just ahead lay Chittagong, simmering under the sun, an unprepossessing

settlement on the estuary of the Karnaphuli River—docks, moldy buildings, prowling seamen, blackened palm trees, storm-damaged roads. The airport had been closed for three days. It too was underwater.

Even the people in Chittagong admit there is very little to see there. They say, "Go to Rangamati" (known for colorful tribesmen), "See Karnaphuli Reservoir" (a big lake), or "Go to Cox's Bazar" (a seedy resort farther down the Bay of Bengal).

I did not make any more plans. For me this was the end of the line. □

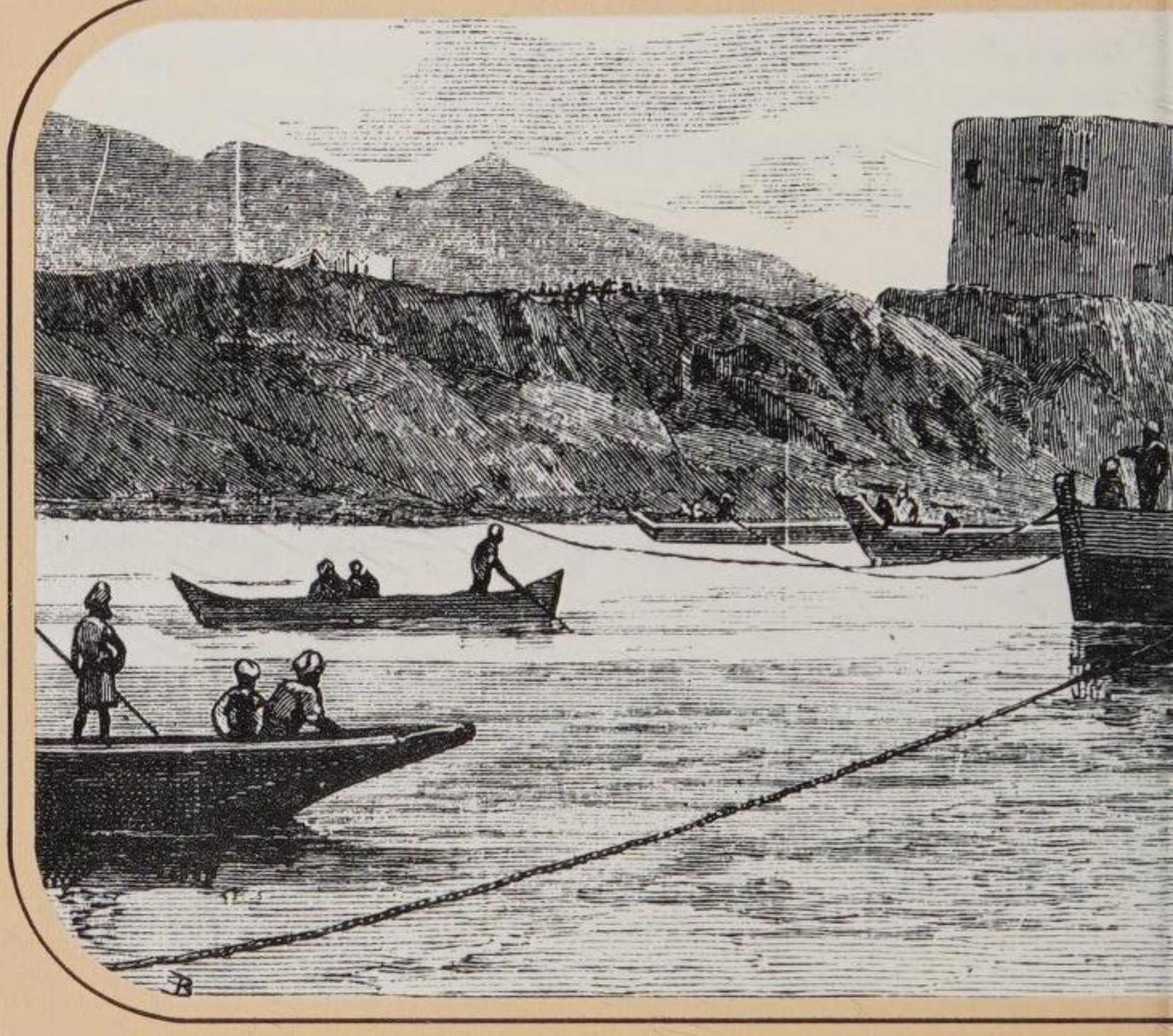


Skinny-dippers' boon, *railroaders' headache, monsoon waters recede from one of the bridges along the Chittagong-Dhaka line that now must be checked for flood damage—and the nation has 3,633 rail bridges. Consisting essentially of one large delta fed by a pair of rivers, Bangladesh is not an easy place in which to run a railroad. But the country's 1,792 miles (2,884 kilometers) of track carry nearly a third of its freight. Its biggest worry today is how to fill the outbound cars since its principal export, jute, is now in low demand worldwide. Meanwhile, this line has been scrubbed up and completely rehabilitated with a loan from the Asian Development Bank.*

38,000 MILES OF TRACK

By MICHAEL G. SATOW

India's



On to the Khyber Pass: *Expanding India's railway to Peshawar in 1881, the first engine is ferried across the*

WHEN, in 1852, Frederick Sleigh Roberts, afterward Field Marshal Lord Roberts, V.C., arrived at Dum-Dum as a young subaltern, no railway yet existed in India. Posted to a regiment at Peshawar, 1,300 miles away on the North-West Frontier, Lieutenant Roberts proceeded up the Ganges to Banaras (now Varanasi) in a barge towed by a steamer, then traveled overland to Meerut by horse *dak* (mail coach). For the final 600 miles he was carried overland in a dooly, or litter, by eight-man relays divided into teams of four bearers; to escape the heat, they traveled at night, led by a torchbearer. In his memoirs Roberts describes the dooly ride as the most tedious portion of the trip.

This trip across the breadth of India took nearly three months. When Roberts departed the country 46 years later, he noted that the same distance could be traversed by train in three days "with the greatest ease and comfort." Few British, at least, still traveled at the dreamy pace of the India Roberts knew as a young man.

Today Indian Railways carries nearly four billion passengers yearly (compared to 300 million in the United States) and 270 million tons of freight on a 38,000-mile network of track. Passengers can travel in air-conditioned comfort (first or second class) or opt not to have air conditioning and know the land, its sounds and smells, and its people in their unchanging fascination.

India, when Roberts arrived there, was governed by the East India Company, whose first charter to trade in the East Indies was granted in the year 1600 by Queen Elizabeth I. Travel was not merely slow; it was often impossible. The monsoon turned the roads to mud and the rivers to flood; dry weather transformed roads into dust bowls and reduced rivers to a trickle. Pilferage was epidemic and delays and damage to goods commonplace. Deployment of troops to areas of unrest was hampered by terrain and climate.

The first proposals for railways in India were submitted in 1843, but much argument and delay ensued before the first schemes came to fruition some ten years later. Many doubted the economic viability of the development plans; others questioned their practicality because of India's difficult terrain, fickle climate, and uneducated populace. The long line of communication between India and Britain slowed proceedings almost to a halt.

Matters dragged on until 1847, when Lord Dalhousie, who had had experience in railway development in England, was appointed governor general of India. He soon brought his

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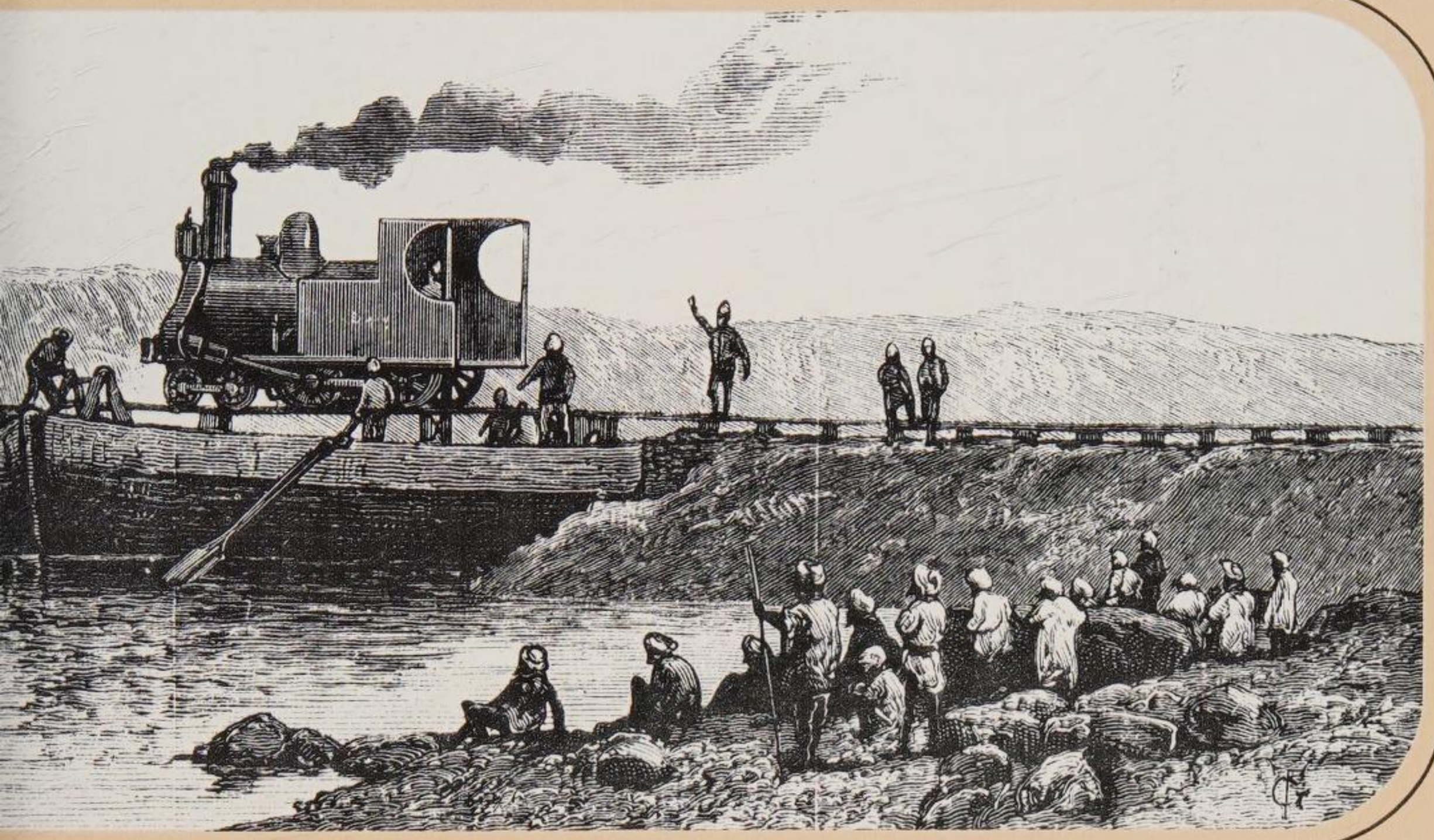
Railway historian **Michael G. Satow,** who lived and worked in India for 15 years, is coauthor of *Railways of the Raj*. He currently resides in England.

Railway Lifeline



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Indus River on boats bearing timbers with track already attached. Bankside ruin remains from a futile effort by Britain's indefatigable engineers to tunnel under the river.

incisive mind and decisive character to bear, and in 1849 agreements were prepared for trial lines to run inland from Bombay (Great Indian Peninsula Railway), Calcutta (East Indian Railway), and Madras (Madras Railway).

The railway promoters from Britain had driven a hard bargain: Rights-of-way and other necessary land were provided free of charge by the government of India, with a guarantee of 5 percent minimum return on capital invested. For its part, the government had considerable powers to dictate the line of the railway and the siting of even minor stations. It also shared the profits in excess of 5 percent and had a right to purchase the railway from the rail companies after 25 years, usually leaving the company to manage affairs on an agency basis.

Lord Dalhousie decreed that only one rail gauge would be used in the land, and settled it at five feet six inches. The first train left Bombay on April 16, 1853, to be followed just over a year later by the East Indian Railway and in 1856 by the Madras Railway.

MILITARY leaders encouraged concentration on a line from Calcutta to Delhi and on to Lahore. By 1857 this line was being built but was incomplete, and it was in that year that the Indian Mutiny (or War of Independence if you were on the opposite side) erupted in Meerut. Astrologers had predicted that the demise of the raj of the East India Company would occur 100 years after the Battle of Plassey; 99 years had passed when the sepoys of the Indian regiments rose up against their officers and briefly seized control of much of northern India.

Whether the completion of the line would have prevented the rising, which was marked by great heroism and slaughter on both sides, is open to doubt; at best it might have shortened the agony and reduced the bloodshed. As it was, the mutiny added a further obstacle to those provided by nature and delayed the progress on the northern lines by some six months. Elsewhere in the country, work continued apace.

★Kabul
KHYBER PASS
Peshawar
Nowshera
★Islamabad
AFGHANISTAN
Kundian
Jammu
H I M A L
Indus
Chaman
Lahore
Simla
PAKISTAN
Bhatinda
Sibi
Hardwar
Bahawalpur
BALUCHISTAN
Jacobabad
Delhi
Meerut
New Delhi
Bikaner
Great Indian Desert
NEPAL
Jaisalmer
Agra
Ganges
Yamuna
Lucknow
Jaipur
Jodhpur
Chambal
Kanpur
Hyderabad
Indus
Karachi
Jhansi
Kota
Varanasi
(Banaras)
Palanpur
Murwara
Gandhi
Dham
Ratlam
Bhopal
Anuppur
Arabian
Sea
Ahmadabad
Narmada
Itarsi
Bilaspur
Raipur
Mahanadi
Jalgaon
Nagpur
I N D I A
Bombay
Matheran
Godavari
Pune
Warangal
WESTERN GHATS
Wadi
Hyderabad
EASTERN GHATS
Kakina
Krishna
Vijayawada
Guntakal
Bangalore
Madras
Mysore
Salem
Ootacamund
Coleroon
Madurai

Part of the British Indian Empire until independence in 1947

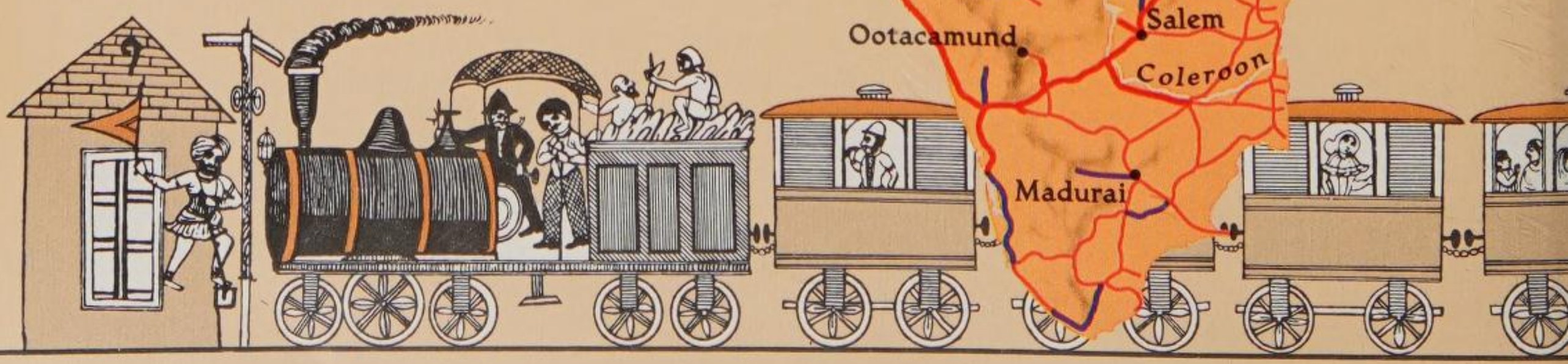
Railroads built after 1947

British-built system:

Broad gauge	1.68 meters (5′6″)
Meter gauge	1 meter (3′3″)
Narrow gauge	Less than 1 meter

0 300 km
0 300 mi

DRAWN BY ISKANDAR BADAY AND JAMES E. McCLELLAND
COMPILED BY ROSS M. EMERSON AND JOHN R. TREIBER
NATIONAL GEOGRAPHIC CARTOGRAPHIC DIVISION



Legacy of empire: India's rail system

SEWING A SUBCONTINENT *together, the imperial raj created a herculean system. A daily average of ten million passengers and 740,000 tons of freight are pulled by 11,000 locomotives over 38,000 miles (61,000 kilometers) of track linking 7,072 stations, all maintained by 1.6 million workers, making Indian Railways the nation's largest employer.*

The first train steamed off in 1853 on one of three lines begun to connect Calcutta, Bombay, and Madras. But surveyors had learned their railroading on much kinder British topography, whereas here they confronted a merciless landscape. Rivers that ran seasonally from trickle to torrent required immense bridges with foundations as deep as 140 feet (43 meters). Sheer outcrops demanded formidable grades, switchbacks, and more powerful engines.

Because two gauges of track had competed in England, a single broad gauge of five feet six inches was decreed for India. But in 1870, to save money, a one-meter gauge was added. Narrow gauges of two feet and two feet six inches followed. To compound the confusion, even after India went metric in 1956, it continued to convert its one-meter-gauge track to broad gauge.

CHINA

TIBET

Mt. Everest 8,848 m (29,028 ft)

Kanchenjunga 8,598 m (28,208 ft)

★Thimphu

BHUTAN

Murkong Selek

Saikhoa Ghat

Darjeeling

Nowgong

Brahmaputra

Darbhanga

Sylhet

Silchar

BANGLADESH

★Dhaka (Dacca)

BURMA

Asansol

Jamshedpur

Dum-Dum

Calcutta

Rangamati

Chittagong

Kharagpur

Cox's Bazar

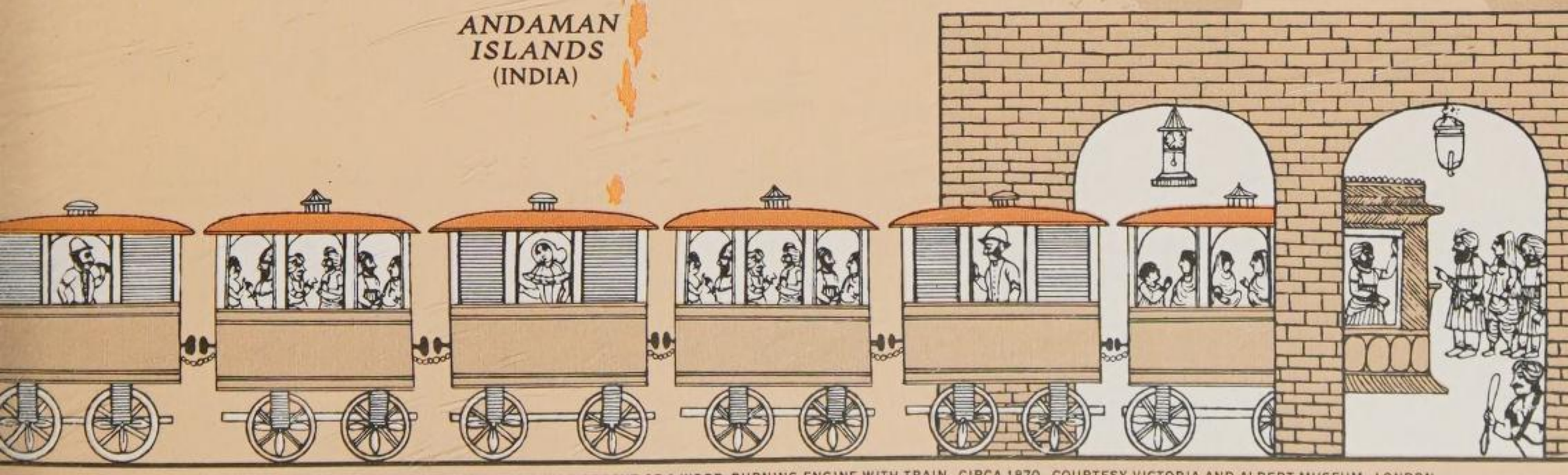
Mouths of the Ganges

Cuttack

Bangladesh, formerly East Pakistan, gained its independence in 1971.

Bay of Bengal

ANDAMAN ISLANDS (INDIA)



DRAWING IS ADAPTED FROM A SIKH WOODCUT OF A WOOD-BURNING ENGINE WITH TRAIN, CIRCA 1870. COURTESY VICTORIA AND ALBERT MUSEUM, LONDON

By 1869 some 4,000 miles of railway, all five-foot-six-inch gauge, had been completed at a cost of as much as £20,000 ($93,000) a mile. At this point the government, by now the imperial raj that had been established following the demise of the East India Company, began to buy railway companies and invest directly in railways. These became known as Indian State Railways.

Short of funds, the government sought to reduce building costs. The result, approved by Lord Lawrence, then viceroy of India, was to overturn Dalhousie's "one gauge" dictum and adopt the narrower gauge of three feet six inches.

In 1870 Lord Mayo became viceroy and, as a first step in the introduction of the metric system to India, changed the gauge to one meter (3 feet $3^3/_8$ inches). The cost of installing meter gauge is roughly half that of broad gauge. Rapid development of two separate meter-gauge systems followed, spurred on by the pressing need for famine-relief lines in the areas north of the Ganges and northwest from Madras.

The maharaja of Mysore, one of many Indian princes who built private railways within their states, solved the problem of travel over differing gauges by having his luxurious saloon car jacked up, complete with occupants, while the wheels and axles were changed.

Today, meter-gauge tracks run the length of India, but it remains impractical to transfer rolling stock from the tracks of one gauge to another. Perhaps confirming Dalhousie's original wisdom, many meter-gauge lines are now being converted to more practical broad gauge.

The period 1870 to 1900 was one of intensive building on both the broad and meter gauges. This period also saw

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With creature comforts, *including Rover under the bed, Europeans traveled first class in the 1880s. A century later India exports its own railway expertise and equipment to many Third World nations. The high-speed* Rajdhani Expresses *now near a milestone by Indian standards: 100 miles an hour.*

construction of the fascinating narrow-gauge scenic hill railways from the plains to hill resorts at Darjeeling, Simla, Matheran, and Ootacamund. The Darjeeling and Matheran lines were built on a gauge of two feet, while Simla used the two-foot-six-inch width. The Ootacamund line was meter gauge and employed a cog system for the steepest grades.

Small though these railways were in scale, they represented major engineering feats. The Darjeeling Railway climbs 54 miles to an altitude of 7,407 feet and must circle upon itself and reverse up zigzags in some places to gain height; the Simla line passes through 103 tunnels in 60 miles to reach nearly the same altitude; the Matheran Railway rises 2,363 feet in 12 miles with 281 curves. In addition, several states and companies developed networks of narrow-gauge railways (mostly two feet six inches) to act as feeders to the main lines.

India entered the 20th century with an extensive and interconnected network of railway lines and an assortment of locomotives and rolling stock operated by dozens of companies. In 1903 the first series of standard locomotives was designed to reduce the problem of spares and operation when locomotives traveled beyond the end of their own company's lines on tracks of the same gauge.

This standardization was not always popular with railway engineers, who had a not unreasonable mistrust of consultants closeted in a London office, but it was important in large-scale military movements over long distances and when equipment had to be borrowed from other lines. The British mold was broken with the introduction of a large number of locomotives imported from the United States during World War II.

Electric and diesel engines are rapidly displacing steam on the main lines, although steam locomotives are still to be found trundling along the meter- and narrow-gauge branch lines. India now builds all its own railway equipment and exports some to other countries.

Electrification was introduced in the 1920s. The heavily traveled suburban lines serving Bombay, Madras, and Calcutta were converted along with the heavily graded main lines out of Bombay and up the Western Ghats. Today the main trunk routes and certain heavily trafficked mining lines are being electrified at 25,000 volts.

THE LAST foreign railwaymen departed India some 30 years ago, leaving behind a tradition that has been maintained with pride and competence. Some measure of the pride may be gained from the establishment, in New Delhi, of a fine and comprehensive Museum of Indian Railways.

The railways of India were built by men and women who toiled stubbornly against appalling odds with primitive equipment and in the most taxing climate. Specialist teams, such as Cornish miners who were short of work in their own country, would often be brought out to undertake such tasks as rock tunneling, while Indians with special skills, such as masons from Rajasthan, followed the railway builders around the land.

In the 19th century, mass labor was the order of the day, with construction gangs of as many as 40,000 souls, sometimes in camps of 10,000 and more. Disease was frequently epidemic. When cholera struck a camp of 10,000 laborers in Baluchistan in May 1885, 2,000 died. They were among 15,000 builders of a line running from Sibi to Chaman on the Afghan frontier through the confused, fissured mountain mass in western Pakistan.

Landslides, mountain torrents, attacks by tribesmen, and the complications of building a roadbed and driving tunnels through a rock face 200 feet above a tumultuous river required heroic efforts. In the six years after its completion in 1887, the line was breached 15 times by landslides and washouts and was finally abandoned in 1942 after part of a cliff face collapsed under the rails.

In the lowlands a British contractor named Solomon Tredwell was engaged to build the challenging line up the Western Ghats between Bombay and Pune. Within two weeks of landing in Bombay, he contracted fever and died. His young widow took over and completed the contract.

Technical skills may at first have come from Britain, but many fine Indian engineers emerged. Much of the work was grand in concept and inspiring in execution. The architects' imagination had free rein; nothing could be more imposing than the Gothic-Saracenic Victoria Terminus in Bombay, or more forbidding than the station at Lahore, fortified with crenellated towers at the corners and massive iron doors at each end to close the openings against attack by insurgents or the hill tribes of the North-West Frontier. Happily, most of this work stands to this day as a memorial to the pioneers of India's railways. □

吉田松陰、金子重輔
下田踏海之図

The 19th-century vision of a new Japan—one that could meet the challenge of the West while

Hagi: Where Japan's

By N. TAYLOR GREGG
NATIONAL GEOGRAPHIC ILLUSTRATIONS STAFF
Photographs by SAM ABELL
Paintings by KINUKO Y. CRAFT

"MY NAME IS TORA," he had written. "Tora means tiger, and the virtue of the tiger is courage."

Yoshida Shoin, born a samurai in the Choshu domain and now bereft of his swords and imprisoned by the shogun, sits stiffly on the floor of his small cell. In front of him, guttering candles throw a flicker of light onto seven or eight faces visible in the shadows. The silence of anticipation is broken only by the hoot of an owl in the pine-scented forest.

The year is 1854, and Yoshida, a teacher, is about to conduct this class as a prisoner. His crime was an attempt to leave Japan, an offense that is punishable by death under a decree of the shoguns that has kept Japan tightly closed for more than two centuries.

He has dared to ask Commodore Matthew C. Perry to take him to America; Perry has refused. Yoshida follows the course of honor and turns himself in to the authorities, partly as a protest. An audacious act by an audacious man.

Yoshida thinks the ban on foreign travel is shortsighted: "It is like a person in a dark room holding his breath."

Perry's coming has made foreign invasion seem imminent;

Cutting through waves *of a sea that had historically walled Japan in and the world out, Yoshida Shoin, a young samurai-teacher, rides in 1854 to a meeting with Commodore Matthew C. Perry, commander of Yankee warships that have shattered the nation's seclusion. "Take me to America," Yoshida asks, convinced that Japan needs to study Western technology to survive.*

holding fast to revered tradition—turned this remote town into a national shrine.

Revolution Began

Samurai fights samurai: *Outraged at the weak shogun for allowing the Americans to force their way into Japan, rebels from Hagi in 1864, led by Yoshida's students, storm Kyoto's Forbidden Gate in a bloody attempt to "steal the jewel"—the emperor himself. Kyoto burned for three days after the attackers suffered a devastating defeat that sent them fleeing back to Hagi.*

THIS PAGE FOLDS OUT

指月山

萩城下町繪圖
萩城

the Japanese have the spirit but lack the technology to resist. Unless Yoshida and other Japanese scholars can travel and study in the West, they feel, Japan will never be able to catch up.

Had Yoshida persuaded this "barbarian" commodore to take him to America, or had he been swiftly executed as specified by law, history doubtless would have followed a different course. For Yoshida was a revolutionary whose ideas would turn the prison upside down, and eventually all Japan.

Feudal Japan was in chaos in the years after Perry's warships first arrived in Edo (now Tokyo) Bay, yet amazed the Western world by quickly emerging to join the circle of modern nations. So swift and so remarkable was the transformation that historians are still arguing about what really happened. (See the map supplement **Historical Japan** with this issue.)

Although the whole country was involved, one feudal domain, the *han* of Choshu, one town, Hagi, and one school, Yoshida's Shoka Sonjuku, were ever near the center of the struggle.

TODAY, hidden far down the rugged coast of southwest Honshu, Japan's main island, Hagi is still thick with the spirit of the warrior—*Bushido*—and with traditional Japaneseness, *Yamato-damashii*. The castle town of the feudal Mori family and birthplace of Yoshida rests in the arms of the River Abu, facing the sea where mists come off the eastern mountains.

The town is something like America's Williamsburg, and among Yoshida's students were a Thomas Jefferson, Patrick Henry, and George Washington. But there the resemblance ends, for democracy was not the goal of these leaders. In their zeal to ward off Western domination, they sought to revive political unity by restoring to the emperor power that his forebears had lost. They then used this unity to bring Japan kicking and screaming into the modern age. A new young emperor named his era of rule Meiji, and what these patriots did has been called the Meiji Restoration.

My first glimpse of Hagi's narrow streets and rows of tightly packed tile roofs comes on a cold night in October. Since sunrise the plush *Shinkansen,* known as the bullet train, has sped me west from Tokyo, but so remote is Hagi that by the time a little local huffs its way into the orange groves that surround the town, it is very late. An icy rain is falling in sheets when I reach the *ryokan*—traditional inn—named Tomoe.

I am greeted with a bow by Kimura-san, the kimonoed hostess. I place my shoes among the rows of others and follow her down long, dimly lit passageways. Everything is made of wood, straw, and paper; the floors creak, and the rain drips loudly into great puddles. A kerosene stove warms my room; the only furniture is a low table bearing a tin of tea and a pot of hot water.

Kimura-san asks, *"Ofuro?"* I nod and follow her downstairs to the steaming baths. Alone, I soak away the weariness of travel.

Returning to my room, I enjoy the sensation of striding freely in kimono, barefoot over tatami mats. I lie down on my *futon*—bed—with a tiny bean-filled pillow under my neck. Outside the paper screen a cold wind rattles the shutters, but the coziness of the room and the effusive warmth of the bath soon carry me into the Hagi night. I fall asleep to dream of other centuries.

ACCORDING TO ancient chronicles the islands of Japan were created by the gods separate and apart from the rest of the world, with the emperor himself a divine descendant of the sun goddess.

Early governments at Nara and later at Kyoto were modeled after the Chinese civil system, with court and nobles under the emperor. In the 12th century a provincial warrior class rose to challenge the court, and a dual system evolved. Yoritomo, the new military leader of the country, had himself

A horseman races with news of war. *Firing a symbolic broadside from empty cannon aboard a commandeered Western-built ship, Hagi's rebels in 1865 serve notice that unless the town's conservative forces yield, they will be destroyed. After winning the castle town, the revolutionaries went on to crush the shogun, ushering in reforms that brought Japan into the modern world with much of its heritage intact.*

appointed shogun. The emperor remained a revered spiritual authority, but in politics he was now only a figurehead.

Japan's complete isolation from the West was broken briefly when the Portuguese arrived in 1543. The Spanish Jesuit missionary St. Francis Xavier followed, and Christianity enjoyed moderate success until the great warlord Hideyoshi decided the church was but a Trojan horse for political conquest. He ordered the "pope's generals" out. His successors, the Tokugawa shoguns, went even further, martyring a number of the faithful. In 1639 almost all foreigners were banned.

The Japanese considered their world already complete in itself, refined in art and manners. They viewed Westerners as crude, materialistic. For the only time in modern history a newly discovered land rejected "progress" and its discoverers, and made it stick.

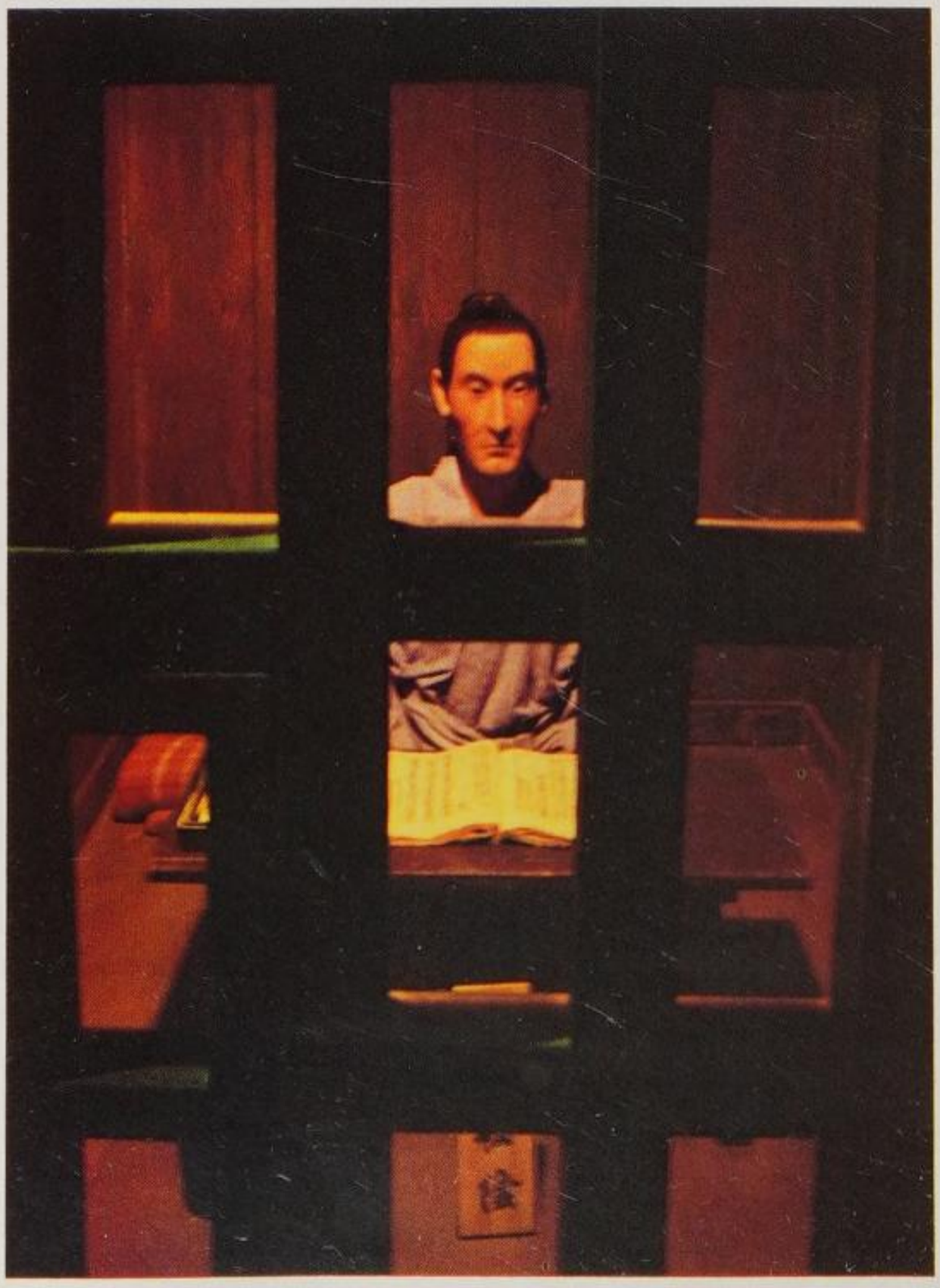
When Yoshida was born in 1830, the country had been closed for almost 200 years. Shoguns of the Tokugawa family had maintained a balance among the country's more than 250 domains. And they had brought to fruit an amazing warrior culture.

Only samurai were allowed weapons. Life was ordered according to strict Confucian principles of duty and family loyalty. Peace reigned, and merchant, artisan, farmer, and samurai all served the shogun and emperor. Japan stood still, wrapped in a cocoon to preserve its unique traditions.

Not so the great nations of the West, powered by the industrial revolution, driven by the urge to expand. England, Spain, Portugal, even the bold young United States, roamed the seas in powerful fleets, seeking commerce and colonies. Britain ruled India and forced opium trade upon China, next door to Japan. News of these events leaked through the paper screen.

By the time Perry arrived in 1853, the ban against Western books had been lifted, and there were small pockets of scholars deeply immersed in *rangaku,* or Dutch studies, as they were called, after the only colony of Westerners permitted in Japan. The areas of greatest interest to these scholars were medicine, mathematics, and military science. They were cautiously attempting a very tricky operation: to cut the superior foreign science free from its barbarian society and transplant it into the pure but aging Tokugawa culture.

"Eastern ethics and Western science"



Power of pen and personality *distinguished Yoshida, who devoted his life to a desperate attempt to change Japan before it was destroyed by the West. Here in a Hagi museum the wax figure of the teacher appears behind bars that imprisoned him after his attempt to leave Japan. Though of the privileged samurai class himself, Yoshida advocated universal education, reward for ability, and the abolition of privilege. At the same time he espoused nativism, a movement that cherished Japanese values such as sensitivity to nature, respect for the spirit, joy in a simple life—values that still refresh Japanese life. In 1859, at age 29, he was executed by the shogun. On the day of his death Yoshida wrote: "If my companions . . . take over my task, the seed of the future will not die." And they did, ensuring Yoshida a hero's place in Japanese annals.*

became the slogan of scholars such as Sakuma Shozan, who was to have great influence on Yoshida Shoin, and who saw clearly that purity of spirit alone would not defeat Western cannon. There was a growing perception that unless some careful modernization was undertaken, the tranquil life of the isolated island empire would be endangered. In Yoshida's birth year, however, few suspected that only 40 years later an epoch would be finished—that they were the last samurai.

I WAKE in the morning refreshed, eager to set out in search of traces of my hero and his disciples, the *shishi,* young men of action, still hidden away in Hagi.

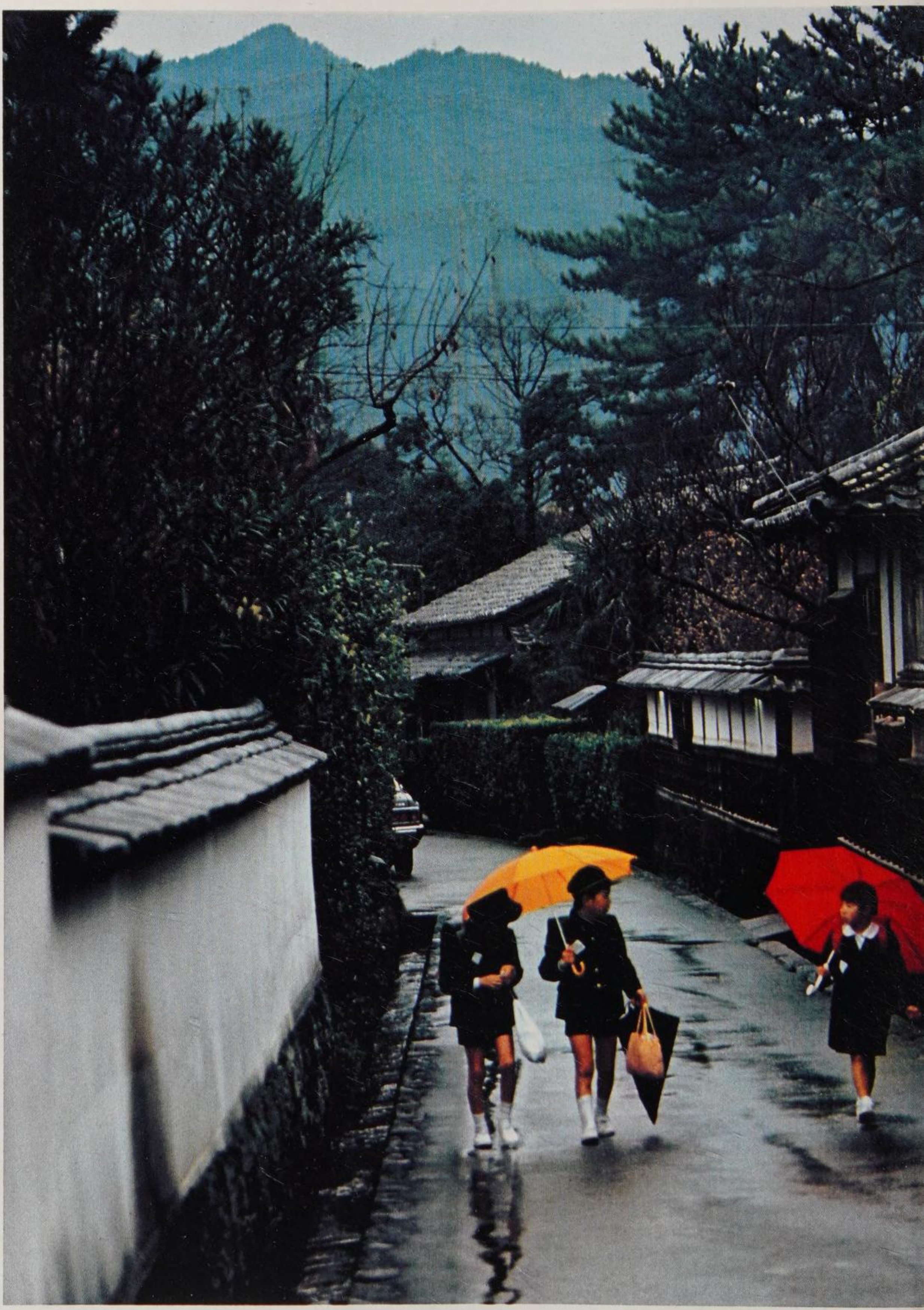
Hagi today is a small city, so small that 20 minutes on a bicycle in any direction takes you across a bridge and out of town, or into the shining sea. The rain is gone, the air brisk, the sky full of scudding white clouds. Feeling the freedom of two wheels beneath me, I quickly cross the eastern fork of the river and head along the coast.

Hagi is protected on two sides by mountains, but open to the sea. From a vantage point on the rim of volcanic Kasa Yama I can see the Hagi fishermen's multitude of boats plying determinedly among the many small sharp islands. Now that samurai stipends are gone, fishing, farming, and the thousands of Japanese tourists who come to see Yoshida's town are the main sources of income. Incredibly, 54,000 people are packed neatly in Japanese fashion into the miniature city below me. As I leave, I see a woman barbecuing fresh squid over a small fire and buy some for my breakfast, dipping it in the rich brown sauce.

It is still early when I pedal back to town and then uphill on the winding road to Yoshida's birthplace. It is not difficult to find. No longer at the center of Japanese politics, Hagi seems frozen in time. They say a map of the 1800s is all you need today.

Yoshida was born into a samurai family relatively low among the many classes of warrior elite; they had to work the land to survive. The farmhouse itself is gone, but the fields worked by his family are still cultivated. Standing there, I have a fine view down across the river, across the tiled rooftops all the way to the castle grounds on the other side of town.

The Mori were once among the most powerful warlords in Japan, but after opposing the Tokugawa rise to power, their holdings



Serenity blesses *a Hagi street that once saw the passion of samurai bent on destroying the shogun. In these and other Hagi homes lived the founders of*

modern Japan—many of them Yoshida's students—such as Ito Hirobumi, who wrote the first constitution and served four times as prime minister.

Dancing for godly favor, *Hagi schoolboys in traditional costume gather at the Tamae Shrine during a fall Shinto festival. Their performance is believed to ensure bountiful fishing. In the cause of nativism, the revolution that restored the emperor's power also made Shinto the state religion of Japan, separating it from a centuries-long intertwining with Buddhism.*

were reduced to this small *han,* Choshu, where they built Hagi castle in 1604.

As if echoing the brevity of Yoshida's life, his birthplace lies not far from his grave, which is marked by a simple stone in the family cemetery. It is only another short distance to the museum that recounts his bizarre career.

The entrance to the memorial compound is a large parking lot, filled with tour buses and hundreds of bicycles. Paths crowded with visitors lead deeper into the spacious grounds. Students in black spread like flocks of Hagi crows, covering every bare spot. The faces are fresh and young, the uniforms alike, except for sneakers in electric colors that flash discordantly on thousands of feet.

"A great *sensei* [teacher]," one student solemnly assures me when I ask what he knows of Yoshida Shoin. He and his class have come here to see the famous Shoka Sonjuku, Yoshida's own little school. Nearby another building displays Yoshida memorabilia: pages from his diaries, a number of his *waka* (31-syllable poems). And far back in the trees, shining with pure white light, is the Shoin Jinja, Shinto spirit home of Yoshida today. Inside the shrine there is no altar, no image to worship, but a space in which to feel.

LATER I work my way through Hagi's tourist-crowded streets to my rooms at the Tomoe Inn to delve again into the histories. The young Yoshida was precocious, they tell me: a robed Confucian scholar at seven, assistant teacher at the famous Choshu academy by nine. At ten he delivered a lecture on military strategy at Hagi castle, earning the lasting admiration of the Mori *daimyo,* or chieftain.

Physically Yoshida was small and unimposing, but he seemed filled with energy and intensity. The man who called himself tiger hardly looked the part; he himself said, "If I have the valor of a tiger, it can only be as a teacher."

At 18 Yoshida wrote a brash *kempaku,* a critical memo (the first of many), urging reforms both in the school and in the country: "We have had a long period of peace

and . . . the people . . . lead luxurious lives and they do not tread any more the true path." He credited Bushido, the strict code of the warrior, with saving Japan from China's fate at the hands of foreigners. The nation, he preached, must be brought back to the simple ways of samurai ethics.

Although related to the martial arts, Bushido was not a fighting technique but rather a way of life, the way of the warrior. Parts of it seem like a Boy Scout code, with instructions for rising early, cleanliness, moderation in dress, courtesy in manner. It called for strict obedience to one's superiors and care and protection of those below. Thus, one served by being polite and by obeying one's father and mother. A samurai served the daimyo; he in turn obeyed the shogun, who was serving the emperor.

It was correct behavior that guaranteed

At home in the beauty and power of nature, *the Japanese maintain a mystical relationship with such places as this private garden in Hagi. Here they steal*

time in escape from the pervasive Western technology that they have made their own since the defeat of the shogunate and the restoration of Emperor Meiji.

peace and tranquillity, and everyone, high and low, was responsible for carrying it out.

But Yoshida Shoin saw great flaws in this ideal realm even before Perry appeared, and he was not alone. A few samurai and lords at the top were rich, but most were impoverished. The strict code of Bushido had given way to personal vanity and indulgence. Yoshida felt that the upper ranks were enveloped in a life of "wearing silk brocades, eating precious foods, hugging beautiful women, and fondling lovable children." Natural calamities, including famine, sometimes went unrelieved, and peasant protests of desperation continued.

Meanwhile, traditional fighting skills declined; samurai swords were gathering rust.

I learned something of samurai swords from Tatsunori Yamaichi, a successful Hagi developer. He lives in a beautiful house that has both Western-style rooms and traditional ones with tatami floors and shoji screens. It looks more modern than any Western architecture I have seen, and yet, of course, we sat on the floor.

Tatsunori-san was giving me a lesson in swordsmanship, a matter of thrust and slash, of points and edges, when he suddenly stopped. "It must be difficult for Westerners to understand Bushido and the sword," he said, "since you invented the rifle, which is merely a killing machine. The sword represented life, a samurai's soul.

"With it he defended the honor of the realm and his daimyo. If he failed, he defended his own honor by taking responsibility and committing *seppuku,* ritual suicide.

"Modern warfare," he concluded, "is just mass killing. Since the Meiji Restoration [1868], swords are merely decoration, impractical for defense."

So, too, with another classical Japanese weapon and ancient art.

One afternoon I rode up through the mountains to a rural school, where archery master Yamane Rinsaku was holding class. In a sunny glade high on a hill behind the school the students addressed their sensei; gravely he bowed back. They were dressed in Western clothes and sneakers, but he, small and neat, wore the traditional teaching kimono. Something in his manner and appearance made me think of Yoshida.

Yamane-sensei faced the target, bow and two arrows held high over his head, then in a single smooth motion brought them down and released one. A piercing scream seemed to rise from his stomach as the arrow flew toward the straw target.

Later in his house we sat sipping tea, and he explained that in traditional archery one achieves perfection by ignoring score in favor of form. Yet even though he teaches the traditional method, students now think of it as a sport, little aware of the idea behind it.

"Traditionally arrow was for killing," said Yamane-sensei. "But modern archery is for fun and health."

FOR A SAMURAI, not only must the body be always ready, skilled in the martial arts, but the mind must be constantly informed as well. Young warriors capped their formal education by traveling within the country, meeting others like themselves. At 20 Yoshida went south, on

foot and by boat, to Kyushu, reading every book he could borrow along the way.

One of the greatest influences on Yoshida was 17th-century military strategist Yamaga Soko, who said, "We are born to die tomorrow, and yet through books we are able to know events of thousands of years."

It is said that Yoshida, to read on summer nights, would put mosquitoes in the sleeves of his kimono to stay awake, and in winter walked barefoot in the snows.

In Nagasaki he met the Dutch and went aboard one of their strange ships. In his ensuing travels he saw how defenseless were the coastlines. In Edo he fell in with Sakuma Shozan and his students of Western learning. Sakuma urged Yoshida and others to study abroad despite the ban on travel.

Yoshida had heard from another sensei that "lately the foreign countries have made great headway and they have invaded many countries of the East; very soon the foreign poison will reach Japan; the whole nation is greatly worried and the people confused."

Fast company and heady ideas seem to have made Yoshida reckless. Travel outside one's own domain was strictly at the pleasure of the daimyo. Impatient, tired of waiting for official permission, he left on another trip without it.

He was later to call this "my first audacious act."

By now he had come to think of himself as a person with a unique vision, someone who saw reality more clearly than others. That vision, he felt, required him to act outside the accepted tenets of society.

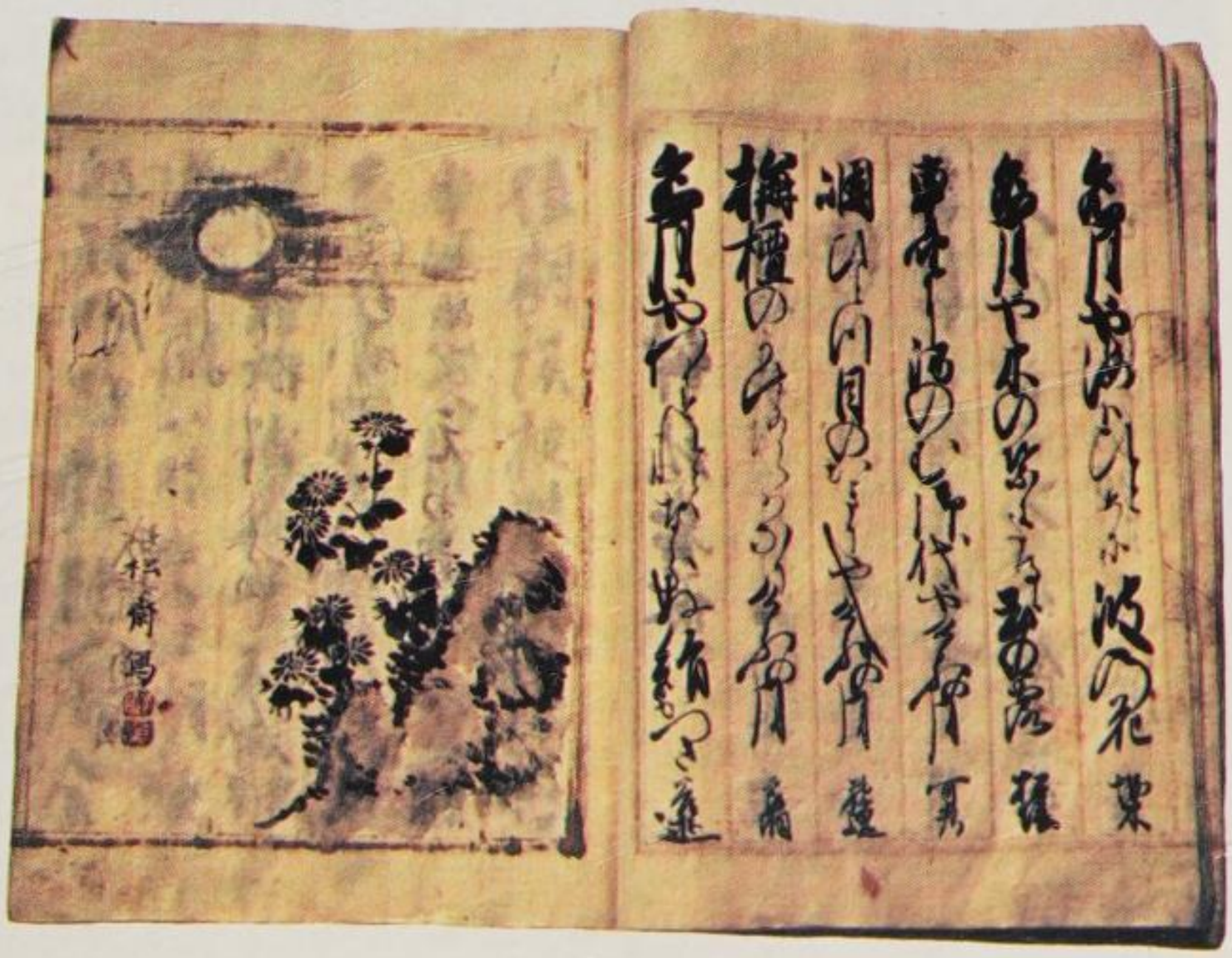
Ordered back to Hagi, he was stripped by the han government of his samurai rank and income. However, this apparently crushing blow early in a promising career took a strange twist. Yoshida had not yet used up all his credit with the Mori daimyo. In a reversal he was forgiven his disobedience and given ten years to travel and study.

He was free at last, free to follow his own path. It led almost straight to Perry, and shortly into the shogun's jail. During these years Yoshida wrote that for Japan to remain free it must be stronger, must recruit men of talent and ability regardless of class. One of the reforms he long had wanted in the han school was the seating of students by achievement instead of by hereditary rank, as was customary.

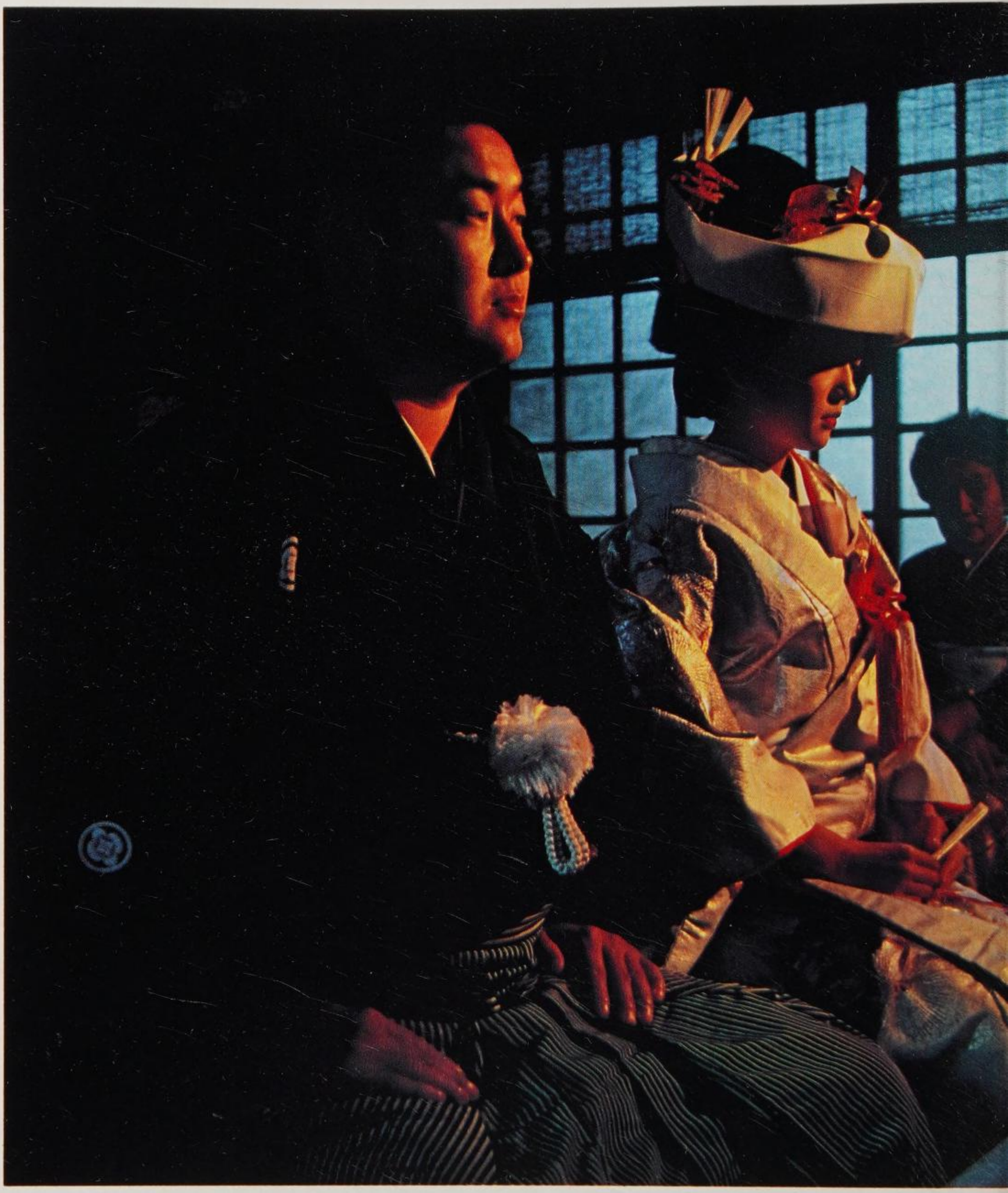
YOSHIDA'S ability to act, to disobey the rules, came from a new realization that the shogun's regime and the sacred realm of the emperor were two separate things; that what appeared to be a fixed holy reality was simply politics.

Although an academic himself, he increasingly preached against "empty learning." He espoused Chinese philosopher Wang Yang-ming's dictum that to know and not to act is not to know. The poet and scholar Yoshida was a true samurai; he believed in the inseparability of the writing brush and the sword. In a letter to a friend he wrote, "Today the country is menaced by thousands of dangers and . . . we cannot expect very much from our writings."

The major danger by now, of course, was the barbarian. The shogunate had attempted internal reforms before Perry appeared,



Service even to death *was the code of the samurai; he used his swords (**left**) to uphold his lord's honor and, if he failed, took responsibility by committing ritual suicide with a short blade. The use of the weapons was thought profane unless guided by a pure heart and knowledge, so the samurai ideal was a scholar who was also a skilled swordsman. Yoshida read voraciously and kept his thoughts, poems, and sketches in many notebooks (**right**).*



including the limited encouragement of Western technology. But still for many Japanese the ideal realm was the one they inherited from Tokugawa Ieyasu; their idea of reform was to return to the 1600s. After Perry they suddenly saw that was impossible.

The shogunate had earlier dismissed Russian and British missions, and during Perry's first visit in 1853 had suggested with smiles and bows that he return later—preferably much later. But when he came back seeking trade concessions in 1854, anchoring his warships athwart the shipping lanes to Edo, the shogun's headquarters, both sides knew that he would not leave empty-handed again.

After Perry's first visit the shogunate asked the daimyos their opinion. Some favored a treaty, but many were outraged by the American blackmail. Some even argued

Rendezvous with tradition *joins a couple in marriage at the Shinto shrine built to house Yoshida's spirit near the school where he taught. By custom the bride's hat is large to conceal the horns of jealousy, while the tassel at her bosom hangs from a small knife—for ritual suicide should she dishonor her husband.*

for an attack on Perry's fleet. Several, including the Mori of Choshu, told the imperial court that they were ready to fight.

But on Perry's return in 1854, the embarrassed and militarily weak shogunate felt that it had little choice but to sign a treaty. The real crisis occurred four years later when the shogunate signed a second treaty against the emperor's wishes. It agreed to a disastrous exchange rate and granted the foreigners exemption from Japanese law. This opened the floodgates.

For patriots like Yoshida this was shocking and totally unacceptable. The government's inability to handle the crisis, and the resulting insult to the emperor and threat to the realm, turned concern into shrill anxiety. The seeds of rebellion were sown.

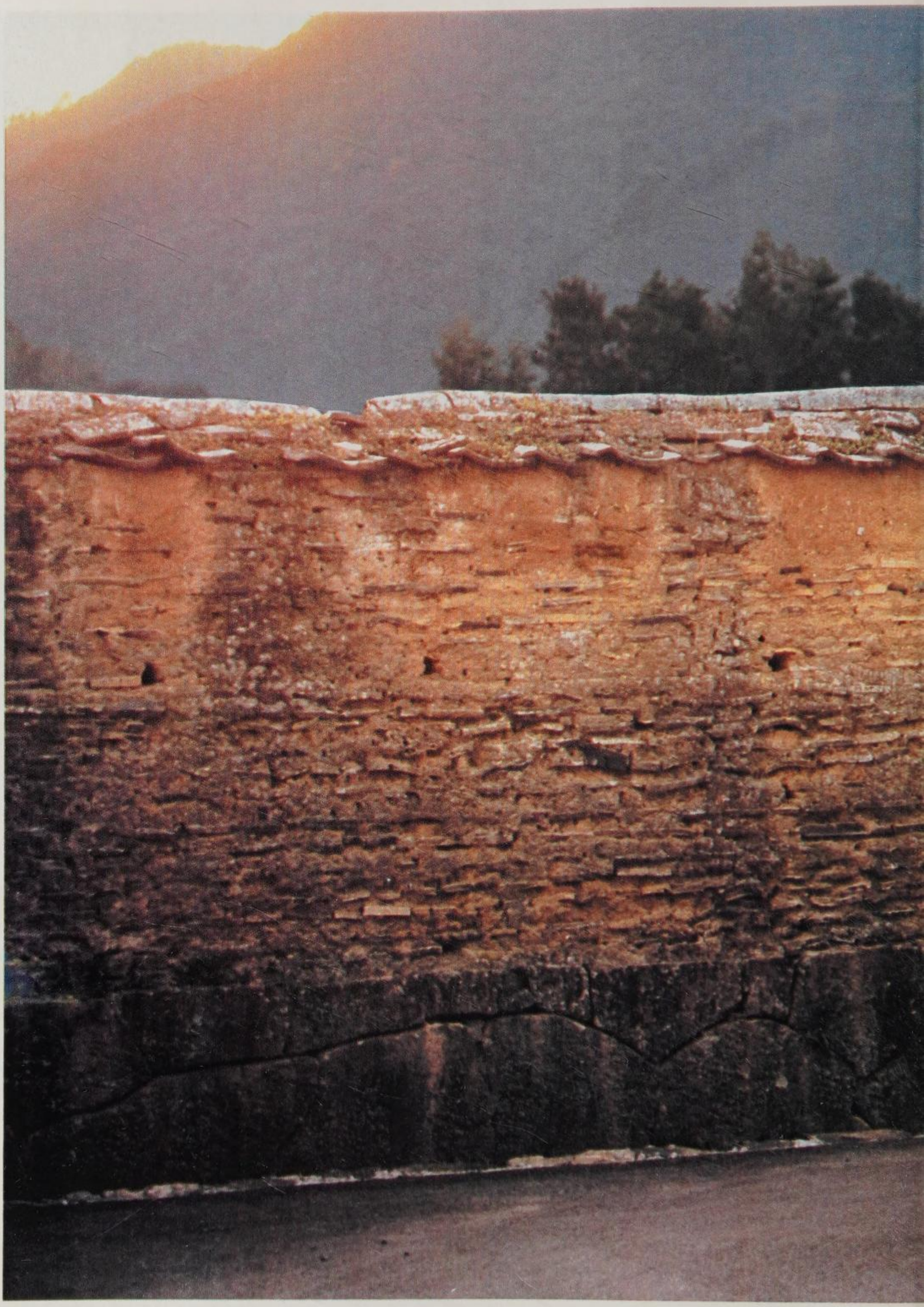
"*Sonno Joi*—Revere the Emperor and Expel the Barbarian"—was originally a popular slogan of support for the Tokugawa shogunate. Now it became the cry of those who wished to topple the inept regime in order to save Japan.

WHILE JAILED for attempting to leave the country on Perry's ship, Yoshida, ever the sensei, conducted classes for his fellow prisoners. And, characteristically, his was a new kind of teaching.

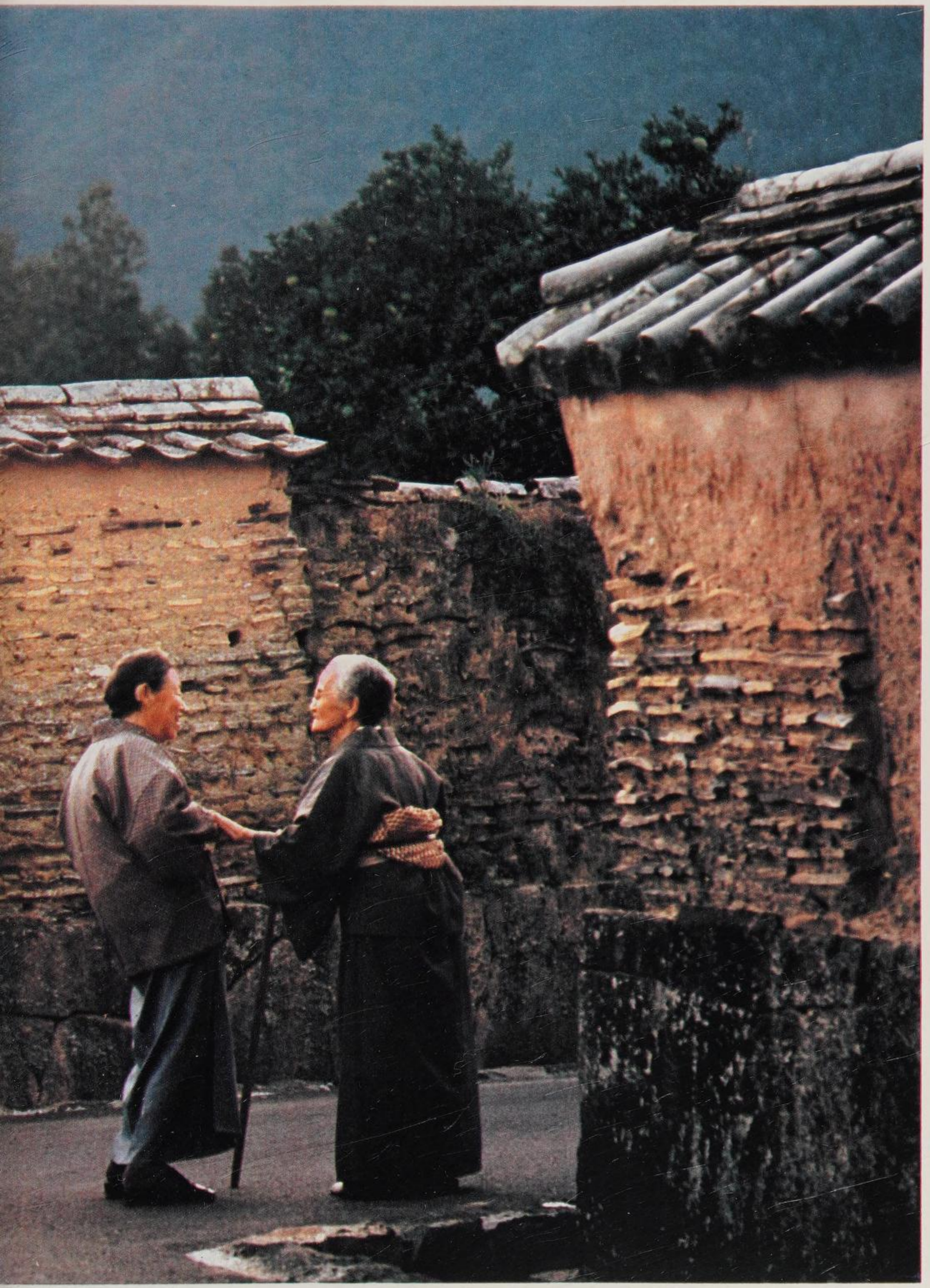
When I visited historian Naramoto Tatsuya, who has spent years studying and writing about Yoshida, he told me: "Yoshida went around the jail, interviewing each man to discover what his talents were and then arranged to have that man give classes to the others. He found one talented in haiku, 17-syllable verse; another knew Chinese philosophy, and so on. Soon the prisoners' pride was restored, and the whole atmosphere of the prison changed. Eventually, Yoshida arranged for the release of many of those in Hagi prison."

When finally released himself, he took over his uncle's tiny school in Hagi, the Shoka Sonjuku. Again unconventionally, he accepted as students anyone who wished to learn—regardless of hereditary class. Most of his students were young, under 30.

According to Professor Naramoto, Yoshida seldom lectured, preferring instead the Socratic method. "He was a humanist, a



Like a maze, *zigzagging walls in the streets of town were built in the 1600s to protect the approaches to the Hagi castle of the Mori daimyo against enemy*



attack. The castle itself, once the stronghold of the powerful family, was dismantled after the Meiji Restoration to prevent its use in counterrevolution.

very warm person. He would give out different texts to different students, sometimes philosophy and often novels." At times he taught in a grassy field, with the class also pulling weeds, helping him with the farming chores. But constantly, passionately, he warned of the dangers the country faced.

The Shoka Sonjuku, or "private academy under the pines," became a highly unorthodox but quite successful center of learning.

Using the school as a base, Yoshida laid the foundations for a tightly knit political organization, aimed at rebellion. He started an in-house newspaper, which he named *Flying Ears, Long Eyes*. Since he personally was prohibited from traveling, he sent his students out all over the realm to act as investigative reporters.

He also took his students to a nearby field where they joined in close-order drill with

Calling back the dead, *flickering candles of the Bon Festival light the way for ancestral spirits returning from a reunion with their families to the Mori cemetery's garden of a thousand lanterns.*

samurai of the brush, and his kempakus, like editorials, flowed rapidly upon each other. Then the shogunate moved to stifle the radicals, rounding them up in Kyoto and Edo, then in the provinces. It was obvious that many would be executed, including some of Yoshida's friends. It was time to put down the brush and take up the sword.

He sounded the call for a general uprising of "retainers of the grassy field," unattached samurai all over Japan. While many refused, a small band of his own students joined him in a plot to assassinate the shogunate's purge leader in Kyoto. The plot failed, and Yoshida was arrested and sent in a small cage to prison in Edo. His students followed along the way to a place under some pine trees. A heavy rain was falling.

In a beautiful poem Yoshida wrote:

This is the journey
From which probably
For me there shall be no return.
Wholly drenched
Is the pine tree of tears.

On the 21st of November, 1859, at age 29, Yoshida was executed. "Today I am to die," he wrote. "But when I think of the four seasons of the year I am comforted. . . . Yoshida . . . has already had his four seasons; he has sent forth his ears [of corn] with ripe grain. . . . If my companions . . . take over my task, the seed of the future will not die."

After quietly thanking a prison attendant, the samurai-scholar, traditionalist, and rebel bowed to the headsman's blade.

local farmers, using sticks for rifles. His drilling of samurai and commoners together was a trial run for the mixed *shotai* rifle companies that would later prove effective against the shogun's armies.

Many in other domains shared Yoshida's feelings; rebellious movements sprang up in hans all over Japan, but in Choshu they were not extinguished.

During this period Yoshida had been a

YOSHIDA DIED nearly a decade before the Sonjuku leaders fulfilled the rebellion he had called for. Although it is called the Meiji Restoration, it was not only restoration of power to the emperor but also a full-scale revolution. The years were bloody, and many of the best and brightest of Yoshida's Sonjuku group were killed. Finally the rifle units advocated by Yoshida and led by his student Takasugi Shinsaku

proved successful. Composed of both samurai and commoners using covertly purchased American Civil War weapons, they won their civil war in Choshu, then marched against the surprised samurai of the shogun.

When it was over, almost all the Sonjuku group that survived became officers in the new government. Their names are familiar to Japanese schoolchildren today: names like Ito Hirobumi, the nation's first prime minister, who wrote a constitution ending feudalism and guaranteeing many individual rights; Yamagata Aritomo, who created a modern army; Maebara Issei, who became a minister of defense. A national education system was created, and a national university open to all classes, based on talent and ability. The new government adopted a Western-style parliamentary system of government. From Western science Japan received the railroad, the telegraph, a postal system, and modern weaponry.

Even more drastic, the feudal domains were turned into prefectures; the daimyos gave place to governors. And the most dramatic act of all was the law that made it illegal to dress or act like a samurai. The privileged class was ended by the last samurai themselves.

The coming of Perry and the actions of Yoshida Shoin and his disciples had set in motion a series of events that snapped the long cord of Japanese history. The perceived notion of the world was broken, and it shattered like glass.

And yet, picking and choosing from the world of modern Western powers—Germany, France, the United States, and Great Britain—they made something new, and totally Japanese. As Emperor Meiji put it in a poem that became a motto for the new age:

May our country,
Taking what is good,
And rejecting what is bad,
Be not inferior
To any other.

WHEN it is time to leave Hagi, I know I still have many questions. On a final ride through town, as I pedal slowly along the crowded shopping arcade, I encounter a familiar figure

Seeing with eyes *of the heart—known as mono no aware in Japanese—describes the way to understand this visual poem of a tree, framed by a window, against a backdrop of roof tiles at Hagi's Tomoe Inn. Set to haiku, a traditional Japanese poetry form, the scene reads:*

A courtyard window
This tree stands, remembering
The old Tomoe.

approaching, a scholar who has told me much of the life of Ito Hirobumi. He too is riding a bicycle. As his eyes widen in recognition, I prepare to wave, only to note that he is bowing. Unfortunately, I have not yet mastered the bicycle bow, and in the process only narrowly avert a head-on collision. I am, I remind myself, still a barbarian.

I hear the crows call in the quiet afternoon as I leave the business area of Hagi and wheel through the section of samurai houses, the houses of Takasugi and the rest, on the way toward the old castle grounds. The ride takes me through streets lined with beautifully straight white walls topped with tiles, and, in places, much older walls whose orange clay and shattered sticks and stones now lie bare.

Ahead stand the great outer ramparts of the castle with their zigzag entrance that prevented any direct charge by enemy hordes. Once inside, there is still a moat to cross before I reach the massive stone foundations, all that remains of the castle keep.

It was dismantled in 1874 to show allegiance to the new government at a time when many samurai felt they had been betrayed by Ito and the others. Some found the new rule lacking in *jin*—warmth and love for the people—that was so much a part of Yoshida; others didn't want to become too westernized. They tried to turn back the clock, to restore the old samurai order. But it was too late. Japan had changed forever.

Maebara Issei, one of those who most revered Yoshida and his teachings, eventually died here in Hagi, leading a revolt against the new Meiji regime. He and others like him are also revered for giving up their lives, even though the cause was lost. In Japan virtue always wins, even when it loses. □

The Ant and Her

"GO TO THE ANT . . . consider her ways, and be wise," urged the ancient writer of the sixth chapter of Proverbs. Thus we know that since antiquity ants have fascinated thoughtful men. Yet to the casual observer these creatures, scurrying across a walk or clustered about a crumb, seem as small as specks, as common as dust. Why should they inspire philosophy?

Look more closely. The Australian sugar ants above, for instance, might at first glance strike us only for their beauty as they pause to greet each other in a woodland. But notice their mouth-to-mouth greeting. With the intricate, tactile language of their antennae, two ants have asked their sisters for food. Without hesitation the sisters spread their antennae, open their mandibles, and feed their begging siblings, sacrificing some of the food they have worked strenuously to harvest and store in their own crops.

Nothing so symbolizes the allure of ants as this act of nurturing. For what the ants mastered back in the depths of prehistory is cooperation. Besides sharing, they have also organized themselves and divided tasks among one another. Often, as with the sugar ants, they have evolved workers of different shapes and sizes suited to specific jobs.

Introduction by CARYL P. HASKINS

World

CAMPONOTUS, ABOUT 10 TIMES LIFE-SIZE; PAINTING BY JOHN D. DAWSON

Notice, for example, how the massive head of the sugar-ant soldier differs from those of her sister workers. Yet they all belong to the same species, the same colony.

Since they first emerged on the earth, more than 100 million years ago, the ants have been learning, in human terms, how to be social. They have thereby not only survived in a harsh world, they have dominated much of it.

Ant colonies are female societies. The queen lays unfertilized—or male—eggs as needed. But the sole job of these drones, when they mature, is to mate for a few moments with a young queen. All worker ants are female. So basically the ant world is a mother-and-daughter universe.

After 60 years of observation and study, I still marvel at how sophisticated the ants' social behavior is. They have evolved complex and subtle communication systems based on scents and body language. Yet all their behavior is dominated by instinct, unencumbered by such unpredictable human traits as emotion or reasoning. The ants thus make a beautiful model for our use

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in studying the roots of animal behavior.

The ants certainly did not invent social behavior. Sociality is so useful to living beings it has been invented many different times in the insect world alone. But the ants clearly have carried it to elegant extremes. The workers of some ant species actually explode when disturbed in order to rapidly spread a chemical alarm to their sisters. Ants are the premier social insects, and it is their amazing social evolution, reminiscent in ways of our own, that draws us to them.

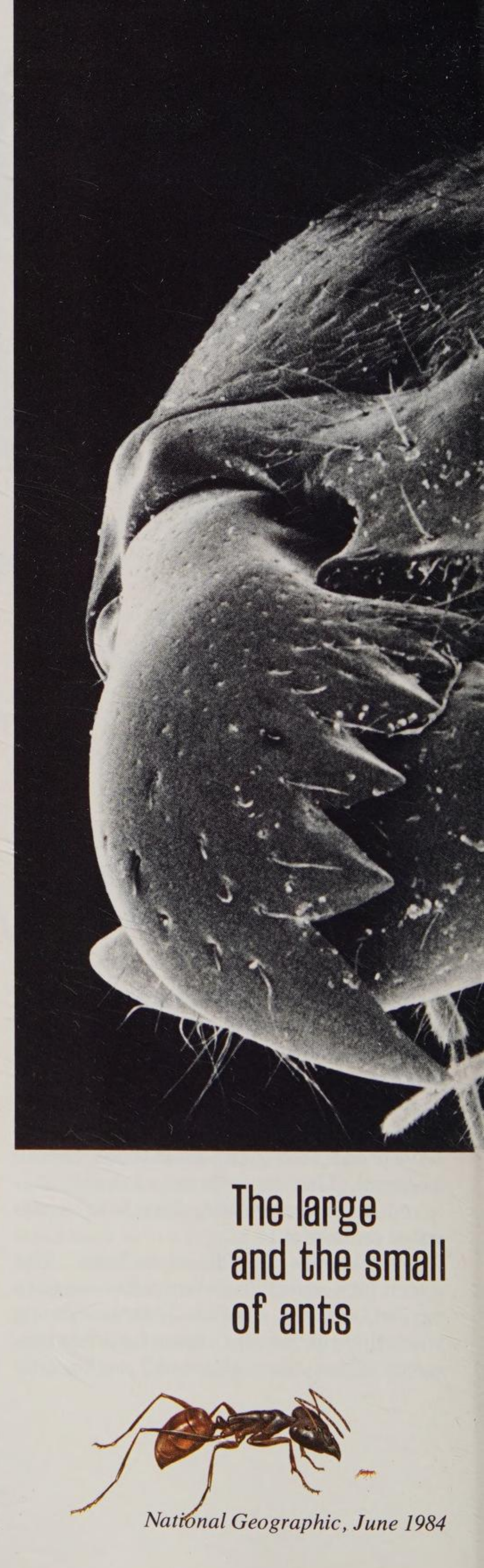
However distant the parallels between societies of ants and men, however impossible it is to draw direct associations between such utterly different species, the ants did have to meet, throughout their long evolution, many of the same problems human societies later had to face. These problems involved both war—intense competition within and between species—and peace—coping with hunger and environmental stress. Surely we humans are but mere neophytes, compared with the ants, in solving these problems.

Moreover, it is by studying ants more than any other animal that scientists have begun to understand the genetic rationale for such traits as altruism and closeness between next of kin.

Yet what is an ant? The electron micrograph at right reveals features of heretofore unimagined complexity. But beyond the details of anatomy, we can list a few basic facts. Between 12,000 and 14,000 species of ants—trillions of individuals—prowl our planet. Like humans, the ants occupy almost every habitable piece of earth. Only permanently snow-covered mountain peaks and the polar regions remain uncolonized.

Some ants sting, some bite, some spray toxic chemicals. None live alone.

Like humans, ants have had an immensely complex and varied social evolution. Clearly it began with lowly hunting communities of perhaps a few dozen individuals. It has culminated in the great ant societies with populations of a million or more individuals per colony. Frequently these colonies include specialized castes of workers and soldiers. They often support a variety of parasites and camp followers. Some herd other insects. Some enslave one another. In the following pages the dramatic panorama of ant behavior unfolds. * * *



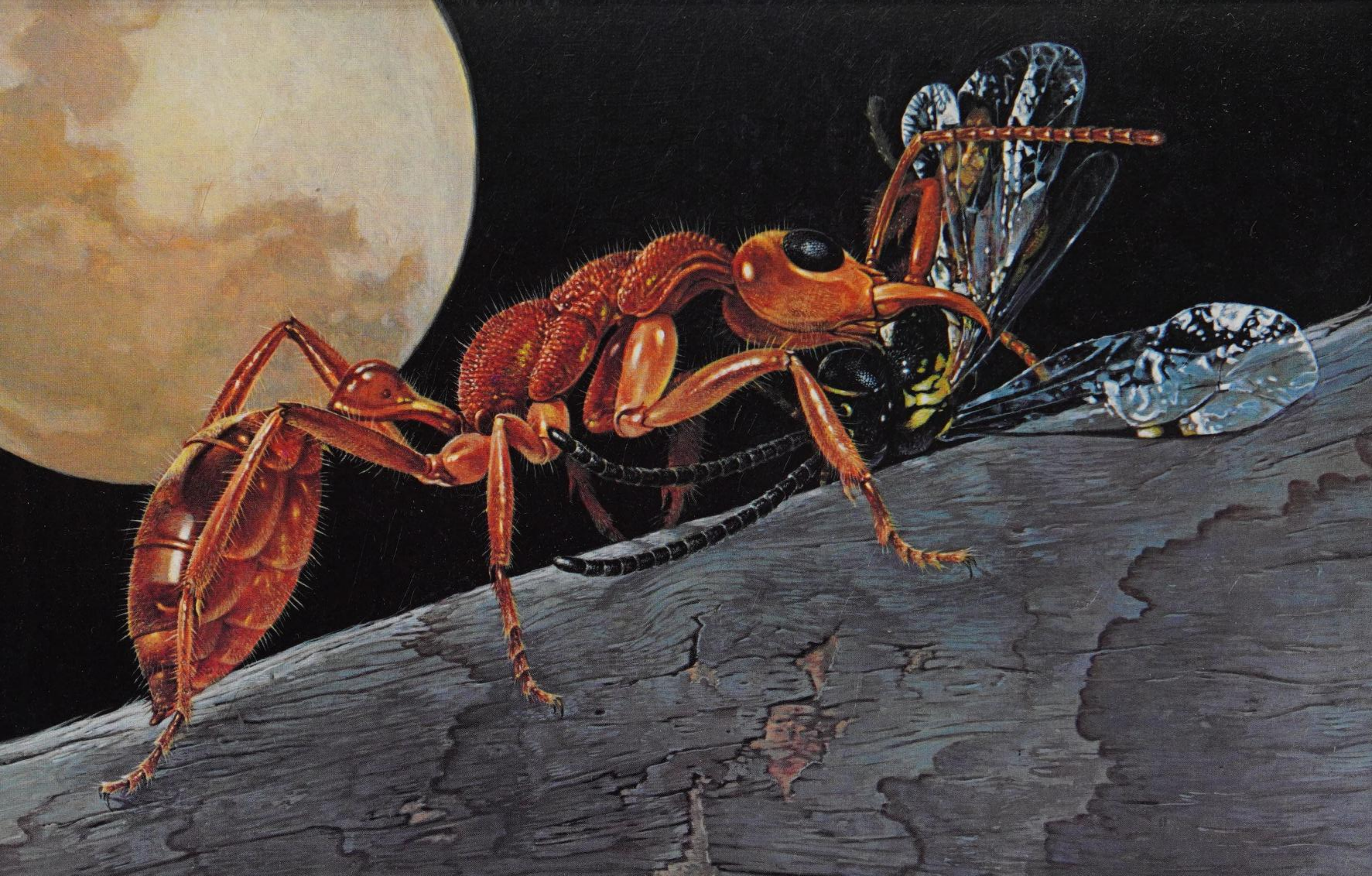
The large and the small of ants

National Geographic, June 1984

PAINTING BY JOHN D. DAWSON (BELOW LEFT) SHOWS CAMPONOTUS GIGAS, LEFT, AND BRACHYMYRMEX ACTUAL SIZE; MICROGRAPH BY ED SELING (ABOVE)

SIZE AND BEHAVIOR *vary dramatically among the thousands of species that make up the world of ants, from this large carpenter ant of Borneo to a miniature from Guyana* (**left**), *placed on her cousin's antenna for a scanning electron microscope portrait* (**above**). *More than 100 such midgets could fit inside the larger head.*

Huge or tiny, an ant carries in her head multiple sensory organs to pick up chemical and visual signals vital to colonies that may contain a million or more workers, all of which are female. The brain contains half a million nerve cells; eyes are compound; antennae act as nose and fingertips. Projections below the mouth sense taste; hairs respond to touch. Mandibles are adapted to a species' behavior; the carpenter's powerful toothed jaws carve wood for nests and dissect insect prey.



The Wonderfully Diverse

Ways of the Ant

By BERT HÖLLDOBLER
Paintings by JOHN D. DAWSON

IN THE COLD Australian night my headlamp illuminated the silvery gray bark of a eucalyptus trunk. We had come to this desolate piece of the outback, my fellow biologists and I, to find a living fossil, the world's most primitive ant. Although I had observed ants all across the earth for some 35 years, I knew this one, called *Nothomyrmecia macrops* (left), only by line drawings in textbooks.

To ant specialists this ancient insect had been a holy grail for nearly half a century. Only two specimens had ever been collected. Those had been delivered in preservative in 1932 to entomologist John Clark of the National Museum of Victoria in Melbourne. They came, along with many other insects, from an amateur naturalist friend of Clark's, Mrs. A. E. Crocker of Balladonia Station in Western Australia. Mrs. Crocker's niece had collected the insects for her aunt on a summer outing to remote Cape Arid.

Nothomyrmecia promised to be a living evolutionary link. Her simple, primeval features resembled those of the long-extinct, 100-million-year-old fossil ants that have been found preserved in amber. Some of these features, such as the shape of head and abdomen, are wasplike. Ants, we believe, evolved from wasps.

Yet the wasp ancestors of ants were solitary insects. The hallmark of ants is their highly advanced social behavior. Ant societies, which are exclusively female, can have a million or more members, each rigidly programmed to behave in the best interests of her sisters. All species of ants are social, whereas many of their closest insect relations, some of the bees and many wasps, still live single lives.

When did the ants first invent their social behavior? One way to answer that question was to find some living colonies of *Nothomyrmecia* and see how far their social life had advanced. *(Continued on page 785)*

Nocturnal huntress, *a worker of the most primitive living ant species known descends a eucalyptus tree in Australia, a dead wasp in her grip. At night, when the cold makes most insects sluggish, these ants forage alone to help feed a subterranean colony of as many as 80. By adapting to extremes of climate, varied food supplies, and life in groups that divide the labor, ants have become the most advanced, abundant, and widely distributed of the social insects. To portray their world, the artist and the author, a Harvard zoologist, collaborated (page 787) on 24 striking ant's-eye-view paintings.* NOTHOMYRMECIA MACROPS, ABOUT 15 TIMES LIFE-SIZE

With teamwork, weaver ants build a nest of leaves

LEAVING THE GROUND *to competitors, weaver ants have made the treetops of tropical Africa, Asia, and Australia their domain. For nests they collaborate to make leafy tents for their queen and her brood of eggs, larvae, and pupae, their food supplies, and*

National Geographic, June 1984

OECOPHYLLA LONGINODA, ABOUT TEN TIMES LIFE-SIZE

themselves. Here forming living haul ropes, a crew of African weavers grasp each other to pull two leaves together. Another team binds the leaves with a silken fastening, using larvae as shuttles. Grasping mature larvae in their mandibles, far right, workers swing the little spinners back and forth, signaling them with their antennae to release sticky threads from glands below their mouths. The larvae give up all their silk to the communal cocoon. Leaf nests, built in about 24 hours, may last more than a month.

En garde! Weaver ants attack to protect their territory

INTRUDERS *from a neighbor colony trigger defense and attack maneuvers among resident weavers, turning mere twigs into battlefields. Confronting a stranger, left foreground, a worker displays hostility with gaping mandibles and abdomen cocked, ready to spray blistering formic acid. For seconds the two box, extending their legs and circling each other jerkily. Next they may seize each other in a to-the-death*

OECOPHYLLA LONGINODA

clinch, like the spread-eagled pair beyond. Rushing toward the silky white nest, at upper right, another ant extends a gland from her depressed abdomen to lay an odor trail, which will lead reinforcements to the fray.

*Meanwhile, a black African stink ant (*Paltothyreus tarsatus*) on a lone forage, right, has been intercepted by a weaver that discharged scented signals to bring nestmates running from nearby. Like a pack of dogs, the weavers surround the giant and subdue her with formic acid. They will carry the corpse to the nest and devour it. A single colony of half a million weavers can maintain 150 nests in as many as 20 trees and patrol 1,600 square meters, one of the largest insect territories known. In China for many centuries the predaceous weavers were used to control insect pests in citrus groves.*

OECOPHYLLA LONGINODA

Stables of scales assure extra food

SILK-WALLED NESTS *become dairies when weaver ants tend sap-sucking scale insects for a food reserve. Small workers collect the rich honeydew released by the bright red scales and store it in their crops. The scales thrive, producing gold-colored young.*

As in many ant species, workers develop in different shapes and sizes, known as castes, each with a distinct function. The smallest weavers, or minors, lick the scales to clean them, collect the discharge, and regurgitate it on demand, foreground. The large worker receiving the food transports it in her crop to sisters in other nests. These large workers, or majors, divide into age groups charged with particular duties. Young majors tend the queen, larvae, and pupae. The middle-aged forage, while oldsters serve as protectors, recognizable by worn mandibles and missing legs. These soldiers live in barrack nests at the edge of the colony's territory. Retaining the sharp eyesight and sense of smell of all weavers, they act as guards and scouts.

(Continued from page 779) So, starting in the late 1940s, the Cape Arid region was repeatedly scoured. No trace of the insect could be found.

On October 22, 1977, Robert W. Taylor and four Australian colleagues were headed west from Canberra for yet another *Nothomyrmecia* hunt. En route their vehicle developed brake problems, hundreds of miles east of Cape Arid, near the hamlet of Poochera. Repairs forced the team to set up camp overnight in that isolated area.

Dr. Taylor is an incurable collector. Even though the night was windy and too cold—just above freezing—for most insects to be active, he wandered off into the bush with his headlamp and collecting vials. As he shone the light on the first tree trunk, he was startled. There, on this frigid night, far from where anyone ever thought to look, climbed *Nothomyrmecia macrops*. Since then some 70 other colonies have been found near Poochera. None has been discovered elsewhere.

IT WAS THREE YEARS later that I found myself shivering with Taylor in the same eucalyptus grove. I was on sabbatical from Harvard University and was eager to see *Nothomyrmecia*. The evolution of social behavior in ants has been my most ardent research interest. Taylor and I planned to take three colonies of *Nothomyrmecia* to his lab at the entomology division of the CSIRO (Commonwealth Scientific and Industrial Research Organization) in Canberra to study their social life in detail.

Research supported in part by your Society

As I scanned one tree trunk, my lamp revealed a glimmer of movement. Then a thrilling sight emerged. Down the trunk crawled a lone huntress carrying a gorgeous, freshly captured wasp in her mandibles.

The wasp, immobilized by the cold, had been easy prey. *Nothomyrmecia,* however, seemed unfazed by the temperature. Taylor believes that *Nothomyrmecia* developed this cold tolerance at some point in her 60-million-year evolution when Australia's climate was much chillier than now.

Nothomyrmecia actually grows inactive when the temperature rises much above 12°C (54°F). That is when most other ants in today's warmer Australia grow busy. Perhaps *Nothomyrmecia* has survived unchanged so long because she can best work the chilly night shift.

We tracked the huntress down the tree, but in the darkness we lost her in the leaf litter. At daybreak, however, we were able to track other foragers home. We marked the tiny entrance to their nest and returned later to excavate the colony.

When we reached the brood chamber, I was even more excited than the night before. There, stunned by the warmth of daylight, lay the queen clustered amid her brood and some 50 workers.

The sight evoked my earliest and strongest memory of ants. It was on a lovely early summer day in Bavaria just before massive air raids brought World War II back home to Germany. I was seven, and my father, who was both a physician and a well-known authority on ants, was home from the war on a brief furlough. We wandered through the fields. He stopped to turn over a stone and uncovered the most marvelous colony of shiny carpenter ants, all swarming around their fat queen. I was fascinated and infused with curiosity.

Later, in the harsh postwar years, I loved to escape to the fields with my dogs to collect ants. With my father's guidance I learned to culture them. With my mother's tolerance I kept many colonies around the house, some running freely. I developed an intuitive sense of what made an ant happy and when a colony was under stress. Ants captivated me. I spent countless hours watching them.

My pride was a colony I raised when I was 14 from a single queen I had caught in the fields right after her nuptial flight. She was still alive when I left home at 25.

Two decades later in Canberra I felt that enthusiasm rekindle as we cultured the three colonies of *Nothomyrmecia* from Poochera. Then we watched to see just what these celebrated ants could do.

I must admit I was somewhat disappointed with the behavior of *Nothomyrmecia*. As Bob Taylor observed, this ancient ant is fully social. She is not the hoped-for missing link between social and solitary behavior. Nevertheless, *Nothomyrmecia* gives us a chance to study primitive sociality in ants.

By using her as our starting point, we can appreciate how far ants have come and how intricate and intriguing their social life has grown.

WHAT DO WE MEAN by fully social behavior? First, consider that an ant colony resembles an extended family. Its members all have a common mother, the queen, and often the same father, one of the drones with which the queen mated. Indeed, one of the criteria of social behavior is an overlap of at least two generations capable of contributing to colony life.

Members of an ant colony are even more closely bonded than a human family. For complex genetic reasons the sisters in an ant colony share an average of 75 percent of their genes. Human siblings by contrast share only 50 percent. Thus an ant colony can be viewed as an army of largely identical genes with a collective genetic will.

Any colony has one overriding goal: to ensure the reproduction and survival of its common genes. The brood therefore becomes the nucleus of the colony. All the cooperative actions we associate with ants —food gathering, colony defense, brood tending, nest construction—center on rearing the next generation.

This imperative demands not only cooperation but also altruism. The female worker ants sacrifice their own fertility because it is more efficient to help raise the eggs of a single, continually laying queen than to lay and rear their own eggs. Likewise, soldier ants automatically risk their own lives to defend a territory needed to feed their colony's brood.

So we can say a fully social ant would have to have a colony spanning more than one generation, enabling sisters to help raise their mother's other offspring. The ants would cooperate in that chore. The colony would also have a division of labor, often a caste system that would assign specific tasks to specialized workers.

In order to cooperate so effectively, ants need a complex communication system that would at very least let them tell nestmates from strangers. This communication is carried out largely through chemistry.

In fact ants are little chemical factories, continuously producing an array of substances, called pheromones, that serves as the ants' language. Through these pheromones the ants can convey messages ranging from the location of food to the presence of danger. They use pheromones as well to orchestrate social behaviors as diverse as tending the young, grooming the queen, marking their territory, and mating.

Nothomyrmecia exhibits all these traits—in a primitive form. The colonies show a division of labor: There are queens, drones, huntresses, and brood-tending workers. Their cooperation, however, is minimal. They hunt alone. They do not lay scent trails to their nests, but navigate home visually.

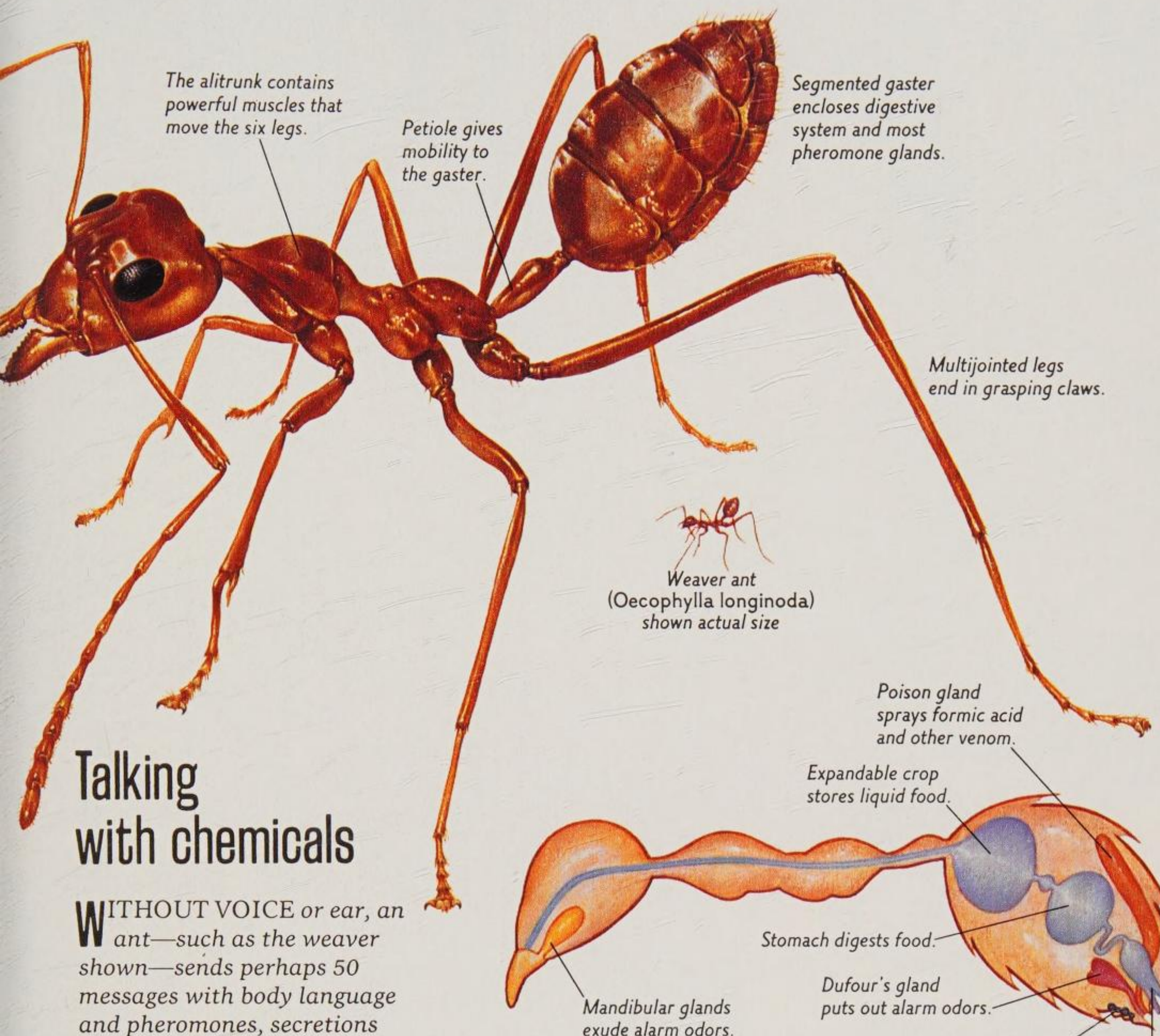
Nothomyrmecia workers appear to mark their nest entrances with pheromones that tell them they are at the right nest. Guard ants at the entrance discriminate nestmates from strangers. They will defend the nest to the death if invaded, but they do not maintain foraging territory. Like most primitive ants their colonies are small, with only about 50 members. That is why they avoid fighting. The death of even one worker is a significant loss to the entire colony.

HOW DIFFERENTLY *Nothomyrmecia* behaves from another ant I had come to Australia to study—the remarkable weaver ant. The weavers may well be the world's most sophisticated ants. Certainly they are one of the evolutionary pinnacles of ant behavior.

You would not guess by looking at a weaver ant next to *Nothomyrmecia* that she was so much more complicated. To the layman the two look alike. Both are reddish brown and about a centimeter long. Although both make their livings in trees, behaviorally they live in different worlds.

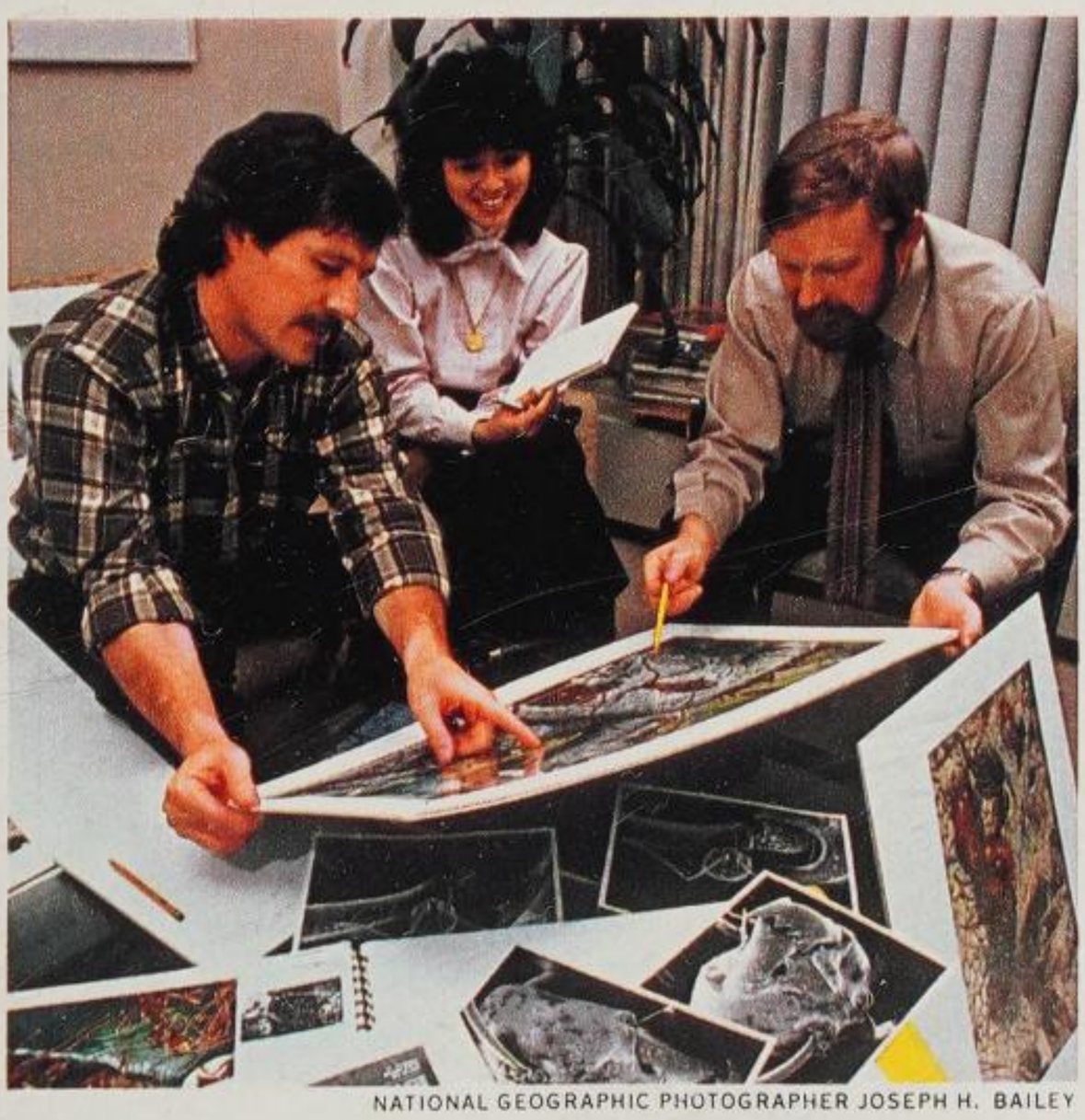
If you disturb *Nothomyrmecia* on a tree trunk, for instance, she simply freezes or flees. No sisters come to her aid. But just upset a weaver ant. Not only does she attack you, but she also releases a suite of pheromones and within seconds five or ten coworkers rush to help her. The weavers have become masters at communicating and cooperating with each other. This is achieved through a sophisticated combination of chemical and body language.

The weavers need a complex communication system. Eons ago their forerunners


The alitrunk contains powerful muscles that move the six legs.
Petiole gives mobility to the gaster.
Segmented gaster encloses digestive system and most pheromone glands.
Multijointed legs end in grasping claws.
Weaver ant (Oecophylla longinoda) shown actual size
Poison gland sprays formic acid and other venom.
Expandable crop stores liquid food.
Stomach digests food.
Dufour's gland puts out alarm odors.
Sternal gland secretions summon workers from nearby.
Hind gut ends in a rectal gland that secretes trail-marking odors.
Mandibular glands exude alarm odors.

Talking with chemicals

WITHOUT VOICE *or ear, an ant—such as the weaver shown—sends perhaps 50 messages with body language and pheromones, secretions from specialized glands.*



NATIONAL GEOGRAPHIC PHOTOGRAPHER JOSEPH H. BAILEY

Teamwork *of the human kind produced this article's remarkable paintings from the perspective of the ant. Author Bert Hölldobler, at right, Alexander Agassiz Professor of Zoology at Harvard University, supplied observations gathered during 35 years of watching ant colonies on five continents. A wildlife artist from Idaho, John D. Dawson, assisted by his wife, Kathleen, meticulously painted from specimens viewed under a microscope and from the author's collection of slides.*

The many-scented queen keeps workers in line

AT THE CENTER of 24-hour-a-day care, the gigantic weaver queen fulfills her primary function, producing thousands of eggs year round. The vast majority of her eggs are fertilized in her gaster from a sperm bank acquired during a single nuptial flight years earlier. These eggs develop into female workers, which are drawn to the queen's body by the attractive chemicals she secretes from an abundance of pheromone glands. But in licking the secretions, workers experience a powerful side effect: infertility. Still, such ants can deliver nonviable eggs to be utilized as food for the queen and voracious larvae. Those larvae that are fed more become majors; those receiving less grow into minors. After spurts of growth, larvae enter the pupal stage for metamorphosis into callow, or immature, workers, and finally into adults.

Once a year the colony raises reproductive offspring. For a short time a queen's eggs pass out of her gaster without meeting the sperm required to produce females. These unfertilized eggs become males. Thereafter, the queen returns to producing fertilized eggs for females. During this period workers feed both female and male larvae so lavishly that the offspring develop into large winged virgin queens and males.

Eventually a resident queen dies. Her workers, no longer absorbing the fertility-inhibiting pheromones, can now lay viable eggs that, unfertilized, become winged males. When the workers, orphaned by the queen's demise, finally die, the colony expires with them. But its genes actually survive, carried by its sons—the winged males that fly off to mate.

OECOPHYLLA LONGINODA

A nuptial flight, a mating frenzy, then death for males

FRENETIC ORGY *of harvester ants takes place on the desert floor of the southwestern United States after rainfall softens the hard soil; most other species join in mid-air. Late on a hot July afternoon, winged males assemble by the thousands at a spot hundreds of*

National Geographic, June 1984

POGONOMYRMEX RUGOSUS, ABOUT 12 TIMES LIFE-SIZE

*meters from their nests. Landing, they discharge secretions that attract virgin queens and other males. As each female arrives, several males grasp her until one succeeds in ejaculating sperm into a pocket inside her gaster (**above**). Others wait a turn. After five or six visits, the pocket is full; the queen frees herself and flies away. Unsuccessful males group under shelter to await possible coupling the next afternoon. Within hours of mating the males die, and the queens have begun the task of starting new nests.*

abandoned the soil, where competition was intense, and took to the underexploited treetops. They adopted the strategy of staking out huge territories, encompassing as many as 20 trees, and then consuming everything they could that entered their realm. Throughout the insect world, only a few other ants claim such vast territories.

The weavers do not restrict their diet to other insects. In coastal Australian mangroves I once observed some 50 ants, all beautifully coordinated, carrying a large, dying hermit crab up a tree.

To defend their large territories, weaver ants must produce enormous numbers of workers. Some colonies can field half a million ants, divided among many nests.

The most important motivation for staking out such large territories may be reproductive. A large colony produces many young queens and drones, and thus stands a better chance of perpetuating its genes.

Weaver ants defend their territory vigorously. Wherever they live, they are among the dominant ant species. Their aggression also serves to ward off birds and other predators, which easily spot the weavers' vulnerable treetop leaf nests.

These tentlike nests, which the workers literally weave together from leaves, give the weavers their name. Their nest construction also demonstrates the spectacular cooperation and division of labor that the weavers have evolved.

Many times I have stood beneath a tree and watched a swarm of weavers overhead form living chains. One ant grasps another's waist and so on, until their chain of bodies reaches a leaf needed for a new nest. Then the living chain contracts, pulling or rolling the leaf into the desired position.

Next, some members of the swarm scurry back to the home nest. Minutes later they return, each ant carrying a white larva in her mandibles. They then move the larvae back and forth across the leaves they want to join together. As they do, the workers stroke the larvae in a way that provokes them to secrete silk. The silk glues, or weaves, the leaf into position.

This remarkable division of labor, in which even the larvae play their role in furthering the well-being of the colony, is what drew me to the weavers. How do they decide en masse which leaf to go after? How do they organize and coordinate their actions? We do not yet know enough to answer those questions. We can only admire the richness of the weavers' communication system.

The weavers also draw on these skills to defend their huge territories so effectively.

In 1978 I studied the territorial mechanisms of African weavers for three months at the Shimba Hills National Preserve in Kenya on a grant from the National Geographic Society's Research and Exploration Committee.

I TOOK NESTMATES from one tree trunk, put them in a box, and went from tree to tree, introducing these ants on trunk after trunk. The introduced ant would rapidly be confronted by a worker

In solitude the young queen founds a colony

HER GREATEST LABOR *ahead, the mated harvester queen lands and breaks off her now useless*

guarding the trunk. Their antennae would meet and convey some kind of message. If the two ants belonged to the same colony, they would scurry off on their own business.

Eventually, I would pass into a new colony's territory. The introduced ant then became a foreigner. When she and the local guard rubbed antennae, both would snap their abdomens skyward, open their jaws, and begin jerking back and forth like sparring boxers, releasing alarm pheromones. Finally they would lock mandibles and try to pull each other apart.

During the fighting, alerted nestmates would race back to the leaf nest, dragging their abdomens along the trunk to lay a scent trail. Soon the tree would come alive with ants as hundreds of defenders streamed to the site of battle.

Why did so many ants rush to the scene? It may be a normal response. Weavers usually respect each other's territories. Colonies clearly mark their borders and typically leave a no-ant's-land in between. Only rarely have I seen weavers fighting without my manipulation. One colony seldom finds it worthwhile to challenge another mature colony, but the rare intruder usually indicates that an army is on the way. Hundreds of defenders must be rapidly recruited.

The weavers employ similar, but less drastic, measures to recruit help when hunting. Say a large insect—more than one worker can handle—is located in the territory. The worker releases a short-range recruitment pheromone. Colleagues quickly race to her side. They grab the prey, spray it with formic acid, and hold it spread-eagled on the trunk for as long as half an hour, until it is subdued.

Besides being predators, the weavers are also cattle breeders of sorts. They have evolved castes of small workers that tend tiny homopteran insects, such as aphids and scale insects, that live on their trees.

The weavers seem to treasure these sap-sucking insects. They protect them with leaf tents. They clean them regularly to prevent

wings. Working alone, she is vulnerable to predatory birds, lizards, and other ants; only one in 100 to 1,000 young queens survives these first days.

Quickly the queen digs her nest with mandibles and forelegs, making balls of the moist soil to lift around the entrance. Once enchambered below the surface, she lays eggs. When they hatch into larvae, she feeds her brood on secretions from metabolized fat reserves and wing muscles. After a few weeks the first generation of 10 to 20 daughter-workers takes over nest digging and foraging. Harvesters gather and store seeds, often affecting the spacing and number of desert plants. When the colony's population reaches several thousand, the queen produces winged males and females. Truly she is queen of all she surveys.

WINGED MALE

WINGED FEMALE

WINGLESS WORKER

POGONOMYRMEX RUGOSUS

them from becoming gummed up in their own defecation. But that defecation is the ants' reward. It is honeydew.

THE ULTIMATE and most important division of labor in any ant colony is sexual. To the queens and drones fall the colony's paramount mission—spreading the genes.

The queen carries the primary burden. That puts her understandably at the center of most ant colonies' attentions. Moreover, she fosters her daughters' devotion. Chemical excretions make the weaver queen, for instance, so attractive to her worker offspring that a dense retinue of workers literally covers her at all times. They frequently lick the surface of her body, particularly her head and protruding membranes on her gaster that are richly endowed with glands.

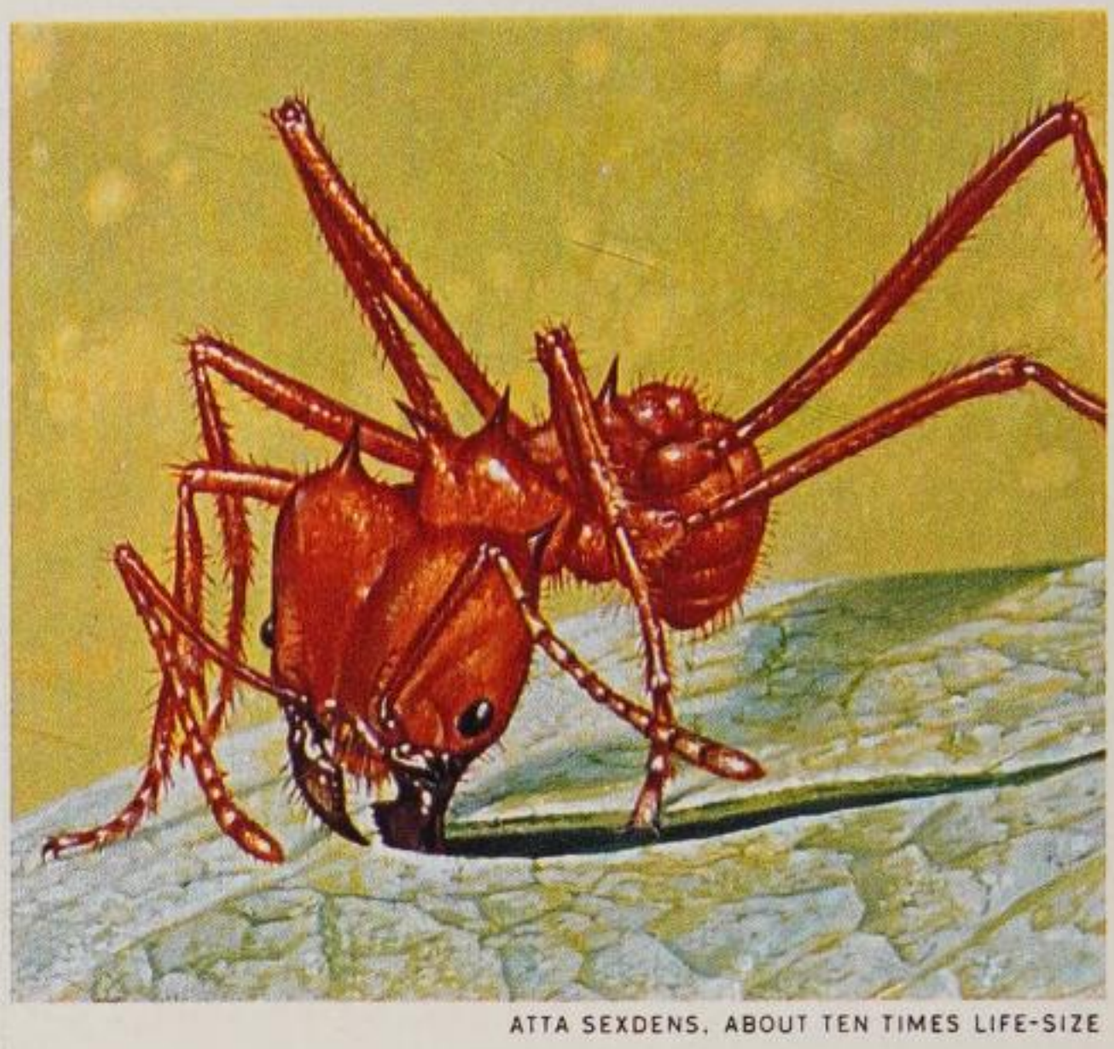
The attendants also feed their queen with astonishing frequency. Within a 20-minute period in our laboratory nest, we saw workers regurgitating food to the queen 20 times as well as feeding her five sterile eggs.

The weaver queen's influence over her half million or so workers is profound. Her presence guarantees strong colony cohesiveness. She maintains her dominance by actually suppressing the fertility of her daughters with potent chemicals. These substances are in the glandular secretions that the workers so eagerly lick from their mother's body and then pass on, probably via grooming and regurgitative feeding, to the rest of the colony.

Before she can settle down to her long life of egg laying, the queen must be a pioneer. On some cue from nature, she takes to her wings and mates, sometimes orgiastically with many males, until she has a lifetime's worth of sperm in her abdomen. Then, facing a gantlet of predators, she must establish a new nest. After producing her first brood of daughters, she begins to release her powerful, fertility-suppressing chemicals.

The drone's role ends with the frenzied glory of the nuptial flight. He dies shortly thereafter, burned out and literally consumed from within by his brief, energy-intensive life of sperm production.

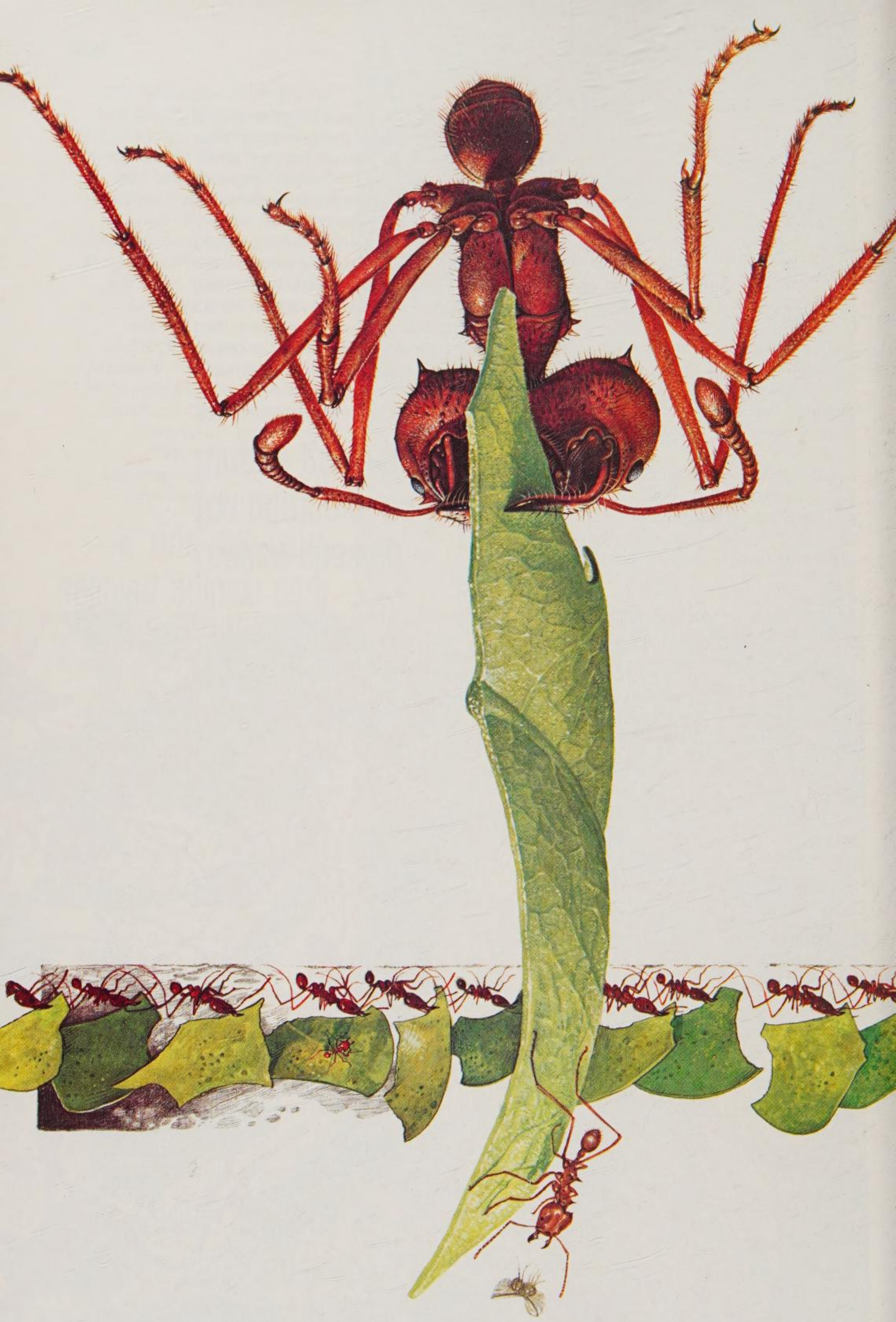
Studying mating behavior in most ants is difficult because much of the action occurs in the air. But the harvester ants of the



ATTA SEXDENS, ABOUT TEN TIMES LIFE-SIZE

Riding shotgun on an ant freight line

SHARP AS A BUZZ SAW, *the serrated mandibles of the leaf cutter (**above**) slice up greenery and then hold the pieces high on the trek (**right**) to the underground nest. The task, going on all night, is carried out by a caste of medium-size workers called medias, assisted by pint-size minors in one of the most unusual roles in the insect kingdom. The hitchhiking minors scurry along the traveling leaf. With flailing mandibles, they protect the carriers against phorid flies that try to lay eggs on living ants. The procession follows a chemical trail some 100 meters long blazed by scouts that lay down an odor reinforced by passersby. Colonies of a million leaf cutters can defoliate a citrus tree in a night; in Central and South America they are considered major pests.*



ATTA SEXDENS

Leaves chewed for compost to feed fungus gardens

AN ASSEMBLY LINE of sorts, leaf cutters process fresh vegetation in chambers resembling padded cells three meters or more beneath the rain-forest floor. One crew chews the greenery to mush; smaller workers add a drop of fecal matter and insert the food into combs blooming with a sponge-like fungus that apparently cannot live outside the leaf cutters' nest. Workers gobble up the fungus heads and also feed them to larvae, lower right, and the queen. The miniature gardeners constantly weed out foreign spores with their mandibles and in licking the fungus spread a secretion containing a fungicide that kills other contamination. Workers haul dead fungus and ants and other refuse outside to a dump that looks like a sawdust pile.

Leaf cutters may move some 40 tons of soil while digging the many chambers of their huge nests. When a virgin queen leaves this nest for her nuptial flight, she takes in a pocket in her mouth a piece of fungus that, like sourdough starter, will seed a fungus garden in her new colony.

Chained together, army ants create a living nest

*ON THE MOVE at all times, a colony of army ants can make no permanent home on the ground or in trees. But each night the workers join together to create shelters out of their own bodies. First, several ants choose an object near the ground, like a log, and dangle from it with their claws interlocked (**left**). Other ants arrive, run down the strands, and fasten on until strands become ropes that fuse into a mass a meter across called a bivouac; home is the entire colony of 200,000 to 750,000 individuals. At the center rests the queen and her brood. In the morning ants begin to disentangle to go out and raid.*

ECITON BURCHELLI, ABOUT SEVEN TIMES LIFE-SIZE

...that dissolves into raiding parties with the sun ▸

*STREAMING from their bivouac near the base of a tree (**following pages,** background), army ants overwhelm a whip scorpion. Their weapons: powerful jaws and deadly stingers. A giant of the soldier caste, with light-colored head and inward-curving mandibles, guards against intruders, lower left.*

Accused of eating everything from pythons to humans, army ants prey mostly on other arthropods—spiders, beetles, grasshoppers, roaches, and other ants. Many insects flushed by the horde fall victim to the bicolored antbird, at left, and the barred woodcreeper, right.

southwestern United States mate mostly on the ground. Tracking them at mating time gave me one of my most unforgettable experiences.

THE HARVESTERS, which make their living by gathering seeds in the desert, produce large winged males and females by feeding a select group of larvae especially well once a year. (Male ants spring from unfertilized eggs, females from fertilized.)

It takes so much energy to make these reproductives that the colony does it only when the young queens stand the best chance of survival. This is just before the rainy season sets in to soften the hard soil in which they must dig their nests.

I had often observed the harvester queens and drones take off on their nuptial flights, but never saw where they went. As I was hiking in the desert in mid-July in 1973, I heard a loud buzzing. I looked down and saw thousands of iridescent wings beating the ground and whirling about. The air reeked with the familiar aroma of ants. I had stumbled across a lek, or a certain place where the sexuals from any one colony instinctively gather each year to mate.

The activity was furious. The males had already arrived and eagerly awaited each young queen. As soon as a female landed, attracted by a pheromone the males collectively had emitted, five or six drones would pounce on her.

Pushing and pulling at each other, the males formed living balls around the queen as they struggled to gain access to her.

Once one got hold of her, he would clamp on desperately with his mandibles. Not infrequently I have seen queens cut in half, running around with no abdomens.

When the female's sperm pocket is filled, she produces a special vibrational signal, like a cricket's rapid chirp. This lets the males know she is ready to leave. She struggles free and flies off to locate a nest site in the moist desert soil. There she breaks off her wings, buries herself, and prepares to raise her new colony. Though she may live for years, she may never again see the light of day. She feeds her first larvae offspring from her own body reserves. These include the rich body fat she carries in her gaster as well as her wing muscles, which are no longer needed and can therefore be metabolized into nutritious juices. After several weeks her first offspring venture into the open to harvest tiny seeds for her. For the rest of her life she will herself be fed.

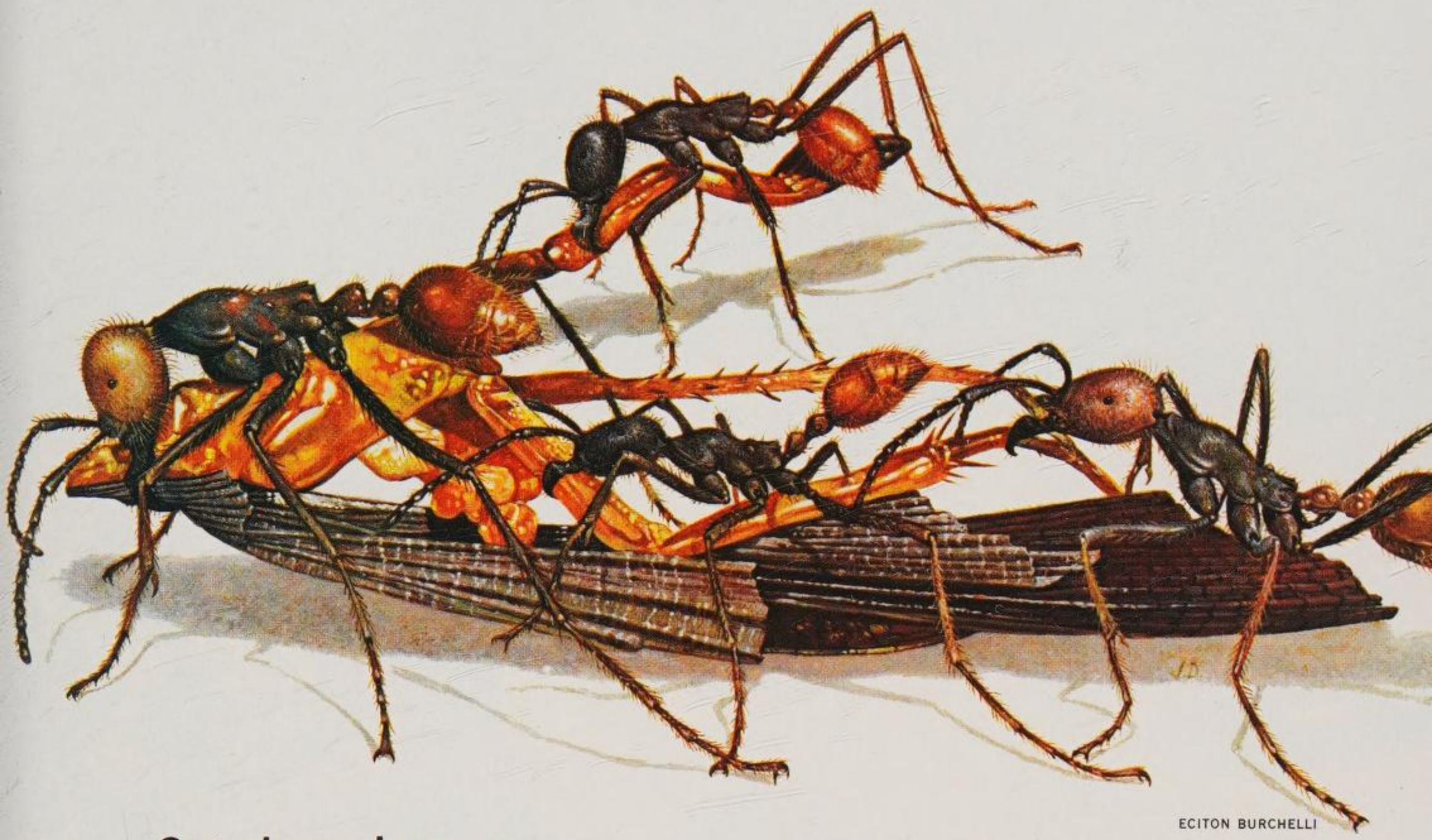
Harvesting seeds is but one of myriad ways ants make a living. *Atta,* the famous leaf-cutting ant of Central and South American rain forests, practices a remarkable form of agriculture (pages 794-6). This lifestyle requires the highest form of division of labor. My colleague Edward O. Wilson, who has analyzed *Atta* behavior in detail, considers their societies to have the most specialized caste system in the ant world.

One caste of *Atta* workers dissects leaves in the jungle and parades the tiny pieces back to the nest. There other castes chew the leaves and inoculate them with a particular fungus that grows only in *Atta* nests. Still other castes tend the fungus patches, applying chemicals that kill any other fungi or invading bacteria.

Atta castes differ dramatically. Members of one worker caste are small enough to ride on the leaf pieces their sisters are bringing home. Their main job is to patrol and fight off parasitic flies that might try to lay eggs on their much larger preoccupied sisters.

Leaf cutter colonies, which may number more than a million workers, require huge subterranean nests to house their extensive fungus farms. In constructing a colony's many underground chambers, ants may excavate 40,000 kilograms (44 tons) of soil. Thus they help aerate and turn over the soils of the rain forest. On the other hand their defoliating habits make them a major agricultural pest.

ANOTHER PINNACLE of coordination has been mastered by perhaps the world's most infamous insect: the army ant. These voracious eaters are the ultimate predators. They maraud for a living. Great columns stream out through tropical forests, creating a panicky flight of small creatures in their paths. Folklore alleges that the ants, in invading villages, have even devoured dogs and horses that were left tethered. Perhaps so in rare instances. Nevertheless, insects and other small creatures form the mainstay of the army ant diet.

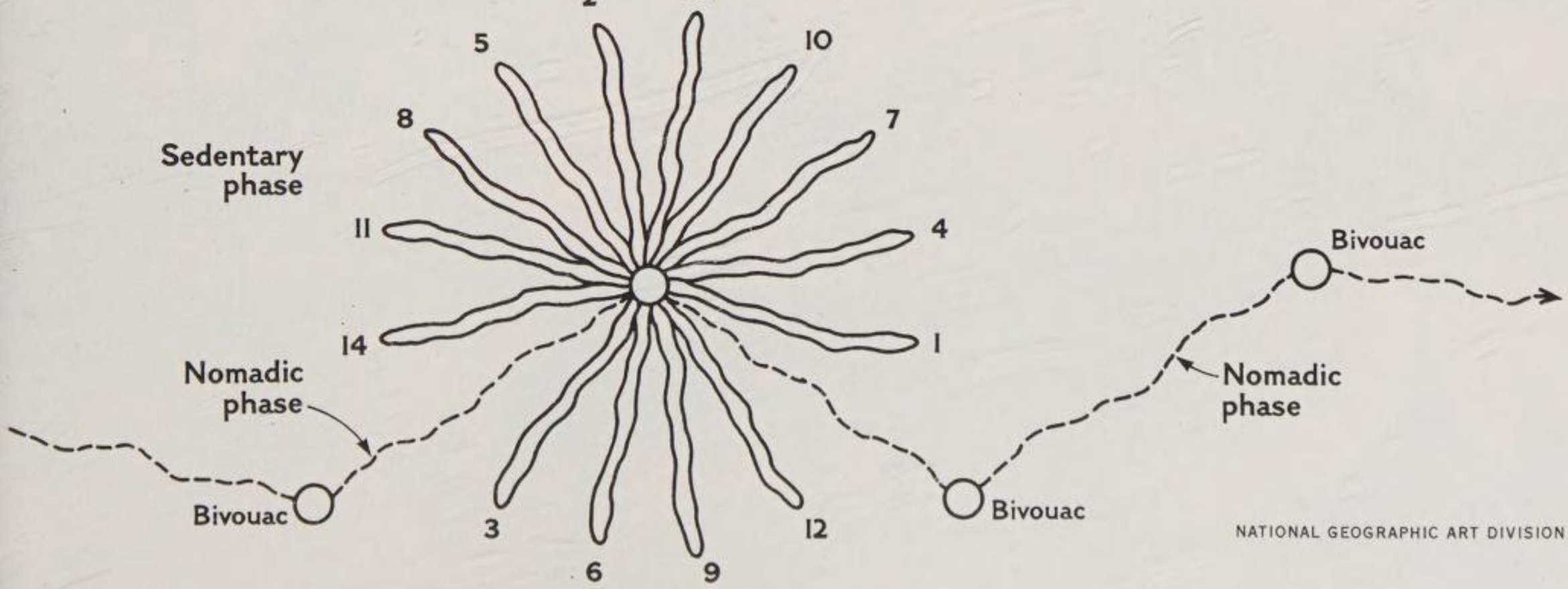


ECITON BURCHELLI

Catch-and-carry by a rain forest cleanup crew

WITHOUT A GENERAL, *army ants coordinate their maneuvers to sling a portion of a cockroach under their legs and carry it to the nest. To hunt most efficiently, the ants time their movements to the needs of a developing brood, alternating between sedentary and nomadic phases. During the resting period of about 20 days, the fat, immobile queen produces 50,000 to 100,000 eggs while other offspring lie in the quiescent pupal stage. On most days workers, foraging only for themselves and the queen, make short raids from the nest in a rosette pattern (**below**), first observed by the author's colleague Nigel Franks in Panama. On each raid they vary their direction by an average of 123 degrees, thus avoiding recombing the same ground.*

After hungry larvae hatch and pupae emerge as callows, the colony becomes nomadic. Workers swarm out at dawn to retrieve all food lying in a 100-meter path; at night the colony starts along the same path to select a new bivouac. The colony continues in the same general direction for two weeks, apparently making sharp turns only if it encounters the scent trail of another group of army ants.



NATIONAL GEOGRAPHIC ART DIVISION

J DAWSON

So ferocious is their appetite that army ants would quickly exhaust their food supply if they stayed in one place. They never camp at one nest site for more than three weeks (diagram, page 801).

Few ants, however, are such nomads. Most species must battle neighbors, often with much loss of life, to establish fixed foraging territories. Once established, territorial borders are usually respected by competing colonies.

But some ants inhabit regions where food resources are so patchy, widespread, and unpredictable that it becomes uneconomical to stake out a fixed territory. These ants find themselves in frequent conflict with their neighbors over whatever food becomes available. Since few ant colonies can afford the loss of life daily battle would bring, some species have developed more sophisticated ways to negotiate with neighbors.

THE HONEY ANTS of the desert Southwest, I recently discovered, actually conduct ritualized tournaments between colonies competing for the same food supply.

The honey ants are so named for their most striking worker caste. These workers, nicknamed honeypots, use their own bodies to store the sweet liquid food the colony often needs to get through hard times in the desert. They are fed until they swell up to the size of blueberries. Then they dangle like amber globes from the ceilings of their chambers until called upon to regurgitate nectar to hungry sisters (left).

I had never even considered that ants might go through rituals, particularly one as elaborate as a tournament. Then in 1974, working in the desert southeast of Tucson, I began noticing unusual congregations of hundreds of honey ants. Obviously two competing colonies were involved. What particularly struck me was these ants' bizarre behavior. All were walking around on stilt legs, as if to make themselves appear as large as possible.

Moreover, many ants were confronting each other one-on-one, going through sparring movements and feeling each other, as if they were taking measurements. They would dash from one to another, repeating these same ritualized movements. Clearly they were not fighting to kill.

Sometimes I would notice one ant leave the tournament and run back to her nest, laying a trail. Soon a fresh army would pour out toward the contest. Then an ant from the opposing colony would rush off to recruit her own reinforcements.

I could not make any sense of this behavior. The ants almost seemed to be playing. For weeks on end I would lie on my stomach in the noon-hot sun, observing and filming. Back home I played and replayed the films in slow motion. I mapped in detail the locations of the tournaments. Gradually the purpose of these rituals emerged.

Typically, food arrives by fortunate accident in the honey ants' harsh environment. If one colony discovers a food supply, say termites in a dung pile, it will want to keep neighboring colonies away. So it will often send an army to engage the neighbors in a tournament. This preoccupies the competitors and prevents them from also exploiting the food source. Tournaments between equal colonies may go on for days until the food in question is exhausted.

The tournaments, however, may serve a second purpose. The measuring and head counting lets the two colonies assess each other's strength. *(Continued on page 811)*

In desert bunkers ants store honey in living casks

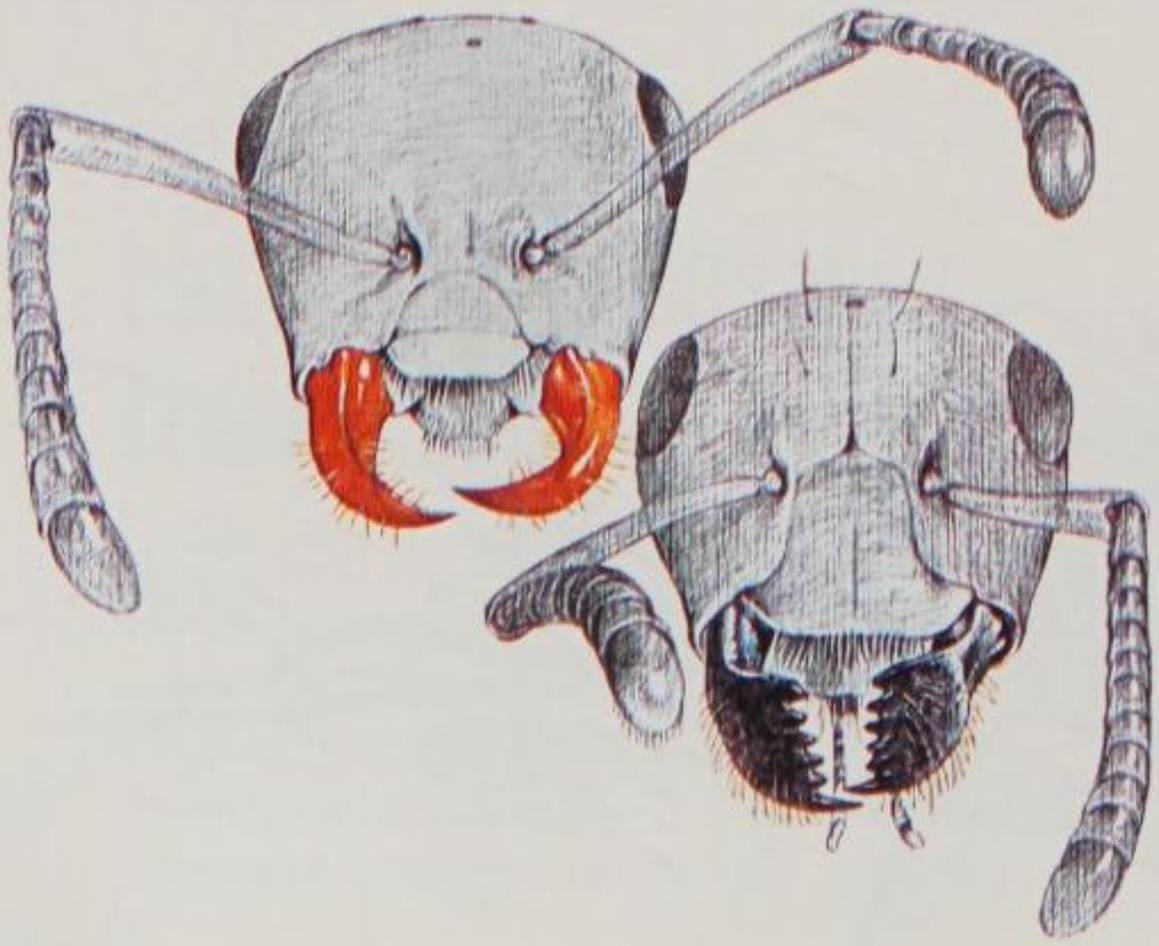
IN TIMES OF PLENTY, *honey ants of Arizona gather termites, nectar from desert plants, and honeydew from homopteran insects, and store the fluids in the best airtight sterile vessels available, the crops of fellow workers, called repletes or honeypots. A forager, foreground, empties her crop into an expanding replete. Other repletes, swollen to the size of peas, cling to the chamber ceiling until, during the dry season, nourishment will be required for the queen, here resting beyond pupal cocoons, the larvae, and the workers. Colonies of 15,000 honey ants keep some 2,000 repletes in storage.*

MYRMECOCYSTUS MIMICUS, ABOUT TEN TIMES LIFE-SIZE

Fighting mock battles in a desert tournament

WHEN RIVALS MEET, *honey ants wage elaborate display, not war. Though the species has no marked foraging territory, workers from different colonies act like enemies when they meet. Confronting foreigners, recognized by odor, workers rise on stilt legs, jostle side by side, and then drum the strangers with legs and antennae, apparently measuring the opponents' size and taking a head count. Reinforcements from each nest join the harmless tourney, which may continue for days. However, if one colony proves considerably weaker in numbers, the game will suddenly end. The stronger army kills the opponents' queen and drags home her brood and honeypots (***right***). Back in the victors' nest, the captives perform tasks as they would in their own colony, a rare instance of intraspecies slavery in ants.*

MYRMECOCYSTUS MIMICUS



Attack of the red raiders makes slaves of a weaker species

FEMALE WARRIORS, *red Amazon ants swarm into the nest of common black ants to capture the brood. Red scouts, which discovered the site and laid trails to it, now lead the advance. Some defenders grasp the brood and attempt*

POLYERGUS RUFESCENS (BOTTOM LEFT) AND FORMICA FUSCA (BOTTOM RIGHT), ABOUT 25 TIMES LIFE-SIZE

to flee. One counterattacks by spraying formic acid. A red's hooklike mandibles sink into the head of another defender.

*The jaws of the red (**left**), specialized for fighting, are useless for the domestic work that the black, with normal mandibles, handles so well. To survive, the Amazons kidnap broods each summer that will develop into workers in the red camp. The captured young are quickly imprinted with the odor of their new nest and accept the slave drivers as sisters, so much so that sometimes slaves join raids against their own species.*

Normally they devote full time to building Amazon nests, foraging for insects, feeding the queen, and tending her brood. Except for slave raids, the parasitic reds, found in the forests and grasslands of Europe and North America, have become totally dependent on their servants.

To found a new colony, a mated red queen steals into a slave ant colony, often killing the resident queen. Her odors prove so attractive that workers give up allegiance to the previous queen and tend the foreign regent instead.

"Highwayman" beetles steal a meal from hardworking ants

ONE OF THE BUSIEST *of insects, the shiny black wood ant of Europe scurries along its trail day and night bringing food not only for its colony but also to feed the fungus that, meshlike, holds together the ants' tree-cavity nest. Certain beetles have broken the communications code of these workers to locate their chemically marked trails and make a living by hunting them or mimicking their behavior.*

*Acting positively antlike, the nitidulid, or highwayman, beetle of Europe (*Amphotis marginata*) approaches a food-laden forager ant and touches her lip, inducing regurgitation of a food droplet, left. When the ant*

LASIUS FULIGINOSUS, ABOUT 17 TIMES LIFE-SIZE

realizes the trick, she attacks, upper right, but the beetle withdraws under its shell, turtlelike.

Staphylinid beetles are even more dangerous. In groups, these rove beetles of the genus Pella, *lower right, pounce on an ant; one bites the back of her neck to immobilize her, then the group drags her away to be eaten. Such rove beetles also lurk near the ants' garbage dumps, eating debris. If discovered and attacked, the beetles have a perfected defense strategy. They offer pleasant secretions from glands in the tip of the abdomen that appease the ants, diverting aggression and permitting escape.*

Some species of beetles have carried their adaptability to such extremes that they can totally camouflage their identity and be adopted within an ant nest, an incredible parasitic relationship that gives the ants no advantage (**following pages**).

J. DAWSON

(Continued from page 803) I suspect that those ants on stilts are trying to bluff their opponents into perceiving them as bigger than they are. After all, only a strong, mature colony—one too powerful to challenge further—would produce so many big ants.

Sometimes, if a colony recognizes that it can overwhelm its considerably weaker opponents, its workers become slave raiders. They invade their opponents' nest. They kill the queen and carry off the nectar-filled honeypots as booty. Most important, they steal the dead queen's brood. When these young ants emerge, they will be unwitting slaves, foraging for the dominant colony and helping rear the offspring of its queen. They thus better ensure her genes' survival.

Slavery is an occasional tactic of the honey ants. Some ants, however, live solely on slave labor. *Polyergus,* the red Amazon ant, for instance, has large, piercing mandibles designed for a life of fighting. These mandibles are useless in doing other work such as foraging, hunting, or brood tending. The Amazons thus must depend on slaves captured from related species for the day-to-day business of living.

As a boy I often observed the spectacle of a red Amazon raid (pages 806-807). I would spot a column two to four meters long and densely packed with the Amazons. I would watch them pour into a neighbor's colony, readily disposing of any defenders.

Slave raiders do not kill needlessly. In fact, some use a propaganda pheromone. They release this chemical, which throws the defenders into a confused, disoriented frenzy, while they grab up the brood.

Once the stolen young hatch in the raiders' nest, they are imprinted with the slave makers' odors. They accept their enslavers as their sisters and service their adopted colony as their own.

ANTS ARE SOMETIMES exploited by other insects. A number of solitary species have learned how to trick ants into providing them a living.

Beetles are the most accomplished of these freeloaders. They have cracked the ants' chemical codes and tactile signals. Some, which I call the highwayman beetles, can locate an ant trail by scent. They then approach food-laden ants scurrying along this trail and mimic the ant colony's food-exchange signals. The ant, sensing the proper signal, feeds the beetle.

Other beetles have learned to emit the ants' very own scents (facing page). They and their larvae can thus live unmolested right inside an ant colony. They also trick their host ants into feeding them and nursing their larvae. Moreover, the larvae of these beetles feed on the ants' brood. That the ants do not recognize these parasites as foreigners illustrates how rigidly ant behavior is dominated by chemical and tactile signals. Ants do what they are programmed to do.

Yet years of ant watching have demonstrated over and over that these creatures are far from simple. In fact, they have much to teach us. For here in the insect world we can observe societies that in many respects are at least as complicated as our own.

We see, furthermore, that in nature such social systems have evolved repeatedly. The ants seem to be saying that on this planet it is an advantage to be social. They cooperate with virtuosity. They do not kill each other recklessly. They do not waste energy. In the evolutionary battlefield, they are survivors.

Yes, we can learn a lot from the ants.

The beetles that came to dinner . . . and stayed

MIMIC WITHOUT EQUAL, *a short-winged beetle* (Lomechusa strumosa) *wins adoption into the family of this European ant by secreting irresistible scents into dense clusters of bristles on its back. The beetle can live only in the ant nest. A worker ant feeds an adult beetle, top, totally oblivious of the large beetle larva, at center, consuming an ant larva unhindered. Two other workers tend ant larvae, lower. The beetles also eat their own larvae, preventing overpopulation of their species and the total elimination of their hosts.*

FORMICA SANGUINEA, ABOUT 15 TIMES LIFE-SIZE

Scourge of the forest, mound-builder ants are a friend to man

DRAGON SLAYERS *of the insect world, European wood ants surround and kill a sawfly larva of the genus* Diprion, *one of the 100,000 insect larvae the colony, numbering a million workers, may consume in a single day. Such sweeps occur in the neighborhood of the distinctive home mound that a colony structures from twigs, pine needles, and bark. Started atop a stump, it may rise to a height of two meters. Its materials and shape encourage runoff of rainwater and insulate its many chambers during long European winters, when the body heat of the ants keeps it warm. Several hundred queens reside here. Newly mated females return each spring to their own or a neighbor mound. In summer the overcrowded colony, like a cell, divides, and a number of queens, each accompanied by several thousand workers, move nearby to start new mounds.*

Because the wood ants serve as a biological control on forest pests, Europeans for years have valued them. Several nations have passed laws against harming the nests. Foresters often cover the mounds with screen to keep out woodpeckers and to discourage humans who would mine pupae for fish and bird food. Nests are often collected by the barrelful and trucked to other forests where wood ants have disappeared. □

FORMICA POLYCTENA, ABOUT TEN TIMES LIFE-SIZE

ILLUSTRATIONS TEXT BY
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Eskimo Hunters of the Bering Sea

By BRAD REYNOLDS Photographs by DON DOLL

Hot tea on an ice floe breaks the chill of early April on the Bering Sea. Out since dawn in the snow, Yupik Eskimos from the west coast of Alaska hunt seals to feed their families. Though modern in their methods, they are traditionalists at heart, living on the edge of a continent, of a culture, of survival.

ABOVE THE ROAR of the motor I heard a voice singing: "Kansas City, Kansas City, here I come." I looked over my shoulder and saw Joe Asuluk grinning in spite of the wind-whipped rain slashing his face. Obviously enjoying himself bucking the high swells, he burst into song again. But our destination was a long way from Kansas City. We were in a 22-foot open boat in the Bering Sea, heading, as best I could tell, toward the Soviet Union to hunt geese.

"You're sure there's land ahead?" I yelled back. He kept grinning as another wave washed aboard.

Joe's boat was a sturdy new Starcraft, powered by an 85-horsepower outboard. And while we sliced through most whitecaps at a fairly smooth angle, time and again we hit one dead on, cascading spray to either side, over the bow, and into the boat. If you didn't bend your head in time, you caught a faceful of salt water.

We were drenched, as well as our guns, but Joe kept singing and steering toward the horizon, where he promised flocks of geese beyond counting.

He knows that his village must hunt and fish to survive.

Joe is both the policeman in Toksook Bay and the cook for its grade school. But in spite of the fact that he earns a salary, he knows that his village must hunt and fish to survive. He hoped to return with a good harvest of geese to share among his people. I wondered if we would return at all.

I had been living in Toksook Bay off and on for more than a year with another Jesuit, Don Doll, making photographs and learning about life in a Yupik Eskimo village. A short visit nine years earlier made me want to spend more time in this remote settlement where 370 people are still dependent upon a subsistence life-style and relatively isolated from outside cultural influences. In an open boat on the stormy Bering Sea, I was beginning to think maybe I had seen enough.

Toksook Bay is a new village perched on the edge of Nelson Island, Alaska, about 150 miles south of the mouth of the Yukon River. Fronting on a bay that opens onto the Bering Sea, the village is surrounded on three sides by low rolling hills and tundra. Not a tree grows on the island. In fact, there is not a tree for more than a hundred miles.

Families from Nightmute, a village inland on Nelson Island, began moving to the site in 1964 to be closer to their summer fishing camp. Some floated their houses across the bay on oil drums lashed together. Others, when winter came, pulled them over the ice on sleds behind dog teams.

John Charlie moved his family from Nightmute to the fledgling settlement that first winter. It took 30 dogs nine hours to drag his house across the ice. John told me about the move and his reason for it with lots of hand signs and the little English he has learned from his own children and the Roman Catholic priest. "From Nightmute to Umkumiut fishing village, too far. Too much gas. Lots and lots of gas."

Most dwellings in the village are three or four rooms, set in haphazard rows along dirt streets and nuzzled by snowmobiles and parts of snowmobiles. Surrounding the homes stand fish houses, where dried fish and sealskin bags of seal oil are stored along with nets, floats, and other equipment. In squat wooden bathhouses the villagers take excruciatingly hot steam baths, and there the elders discuss community affairs. Nearby spread wooden racks for drying salmon, herring, and whitefish.

The village enjoys the unusual luxuries of running water and indoor plumbing. Streets have lights, electricity is available for every house, and telephones have been installed. Not that these modern conveniences come without drawbacks and frustrations. Electricity, provided by AVEC (Alaska Village Electric Cooperative), costs 48 cents per kilowatt-hour. The state pays half, but the villagers' rates are still five times those of Washington, D. C., residents.

Joe Lincoln, local agent for Wien airlines, has racks of radio equipment, as well as two

Brad Reynolds is a writer-photographer based in Seattle, Washington. **Don Doll** teaches photography and chairs the Department of Fine and Performing Arts at Creighton University in Omaha, Nebraska. Both are Jesuit priests.

telephones—one for business, the other for his family. "What good are these phones?" Joe remarked to me as he tried in vain to reach Bethel, 120 miles away. "You call for 30 minutes, and they are busy. Then you call, and they don't answer."

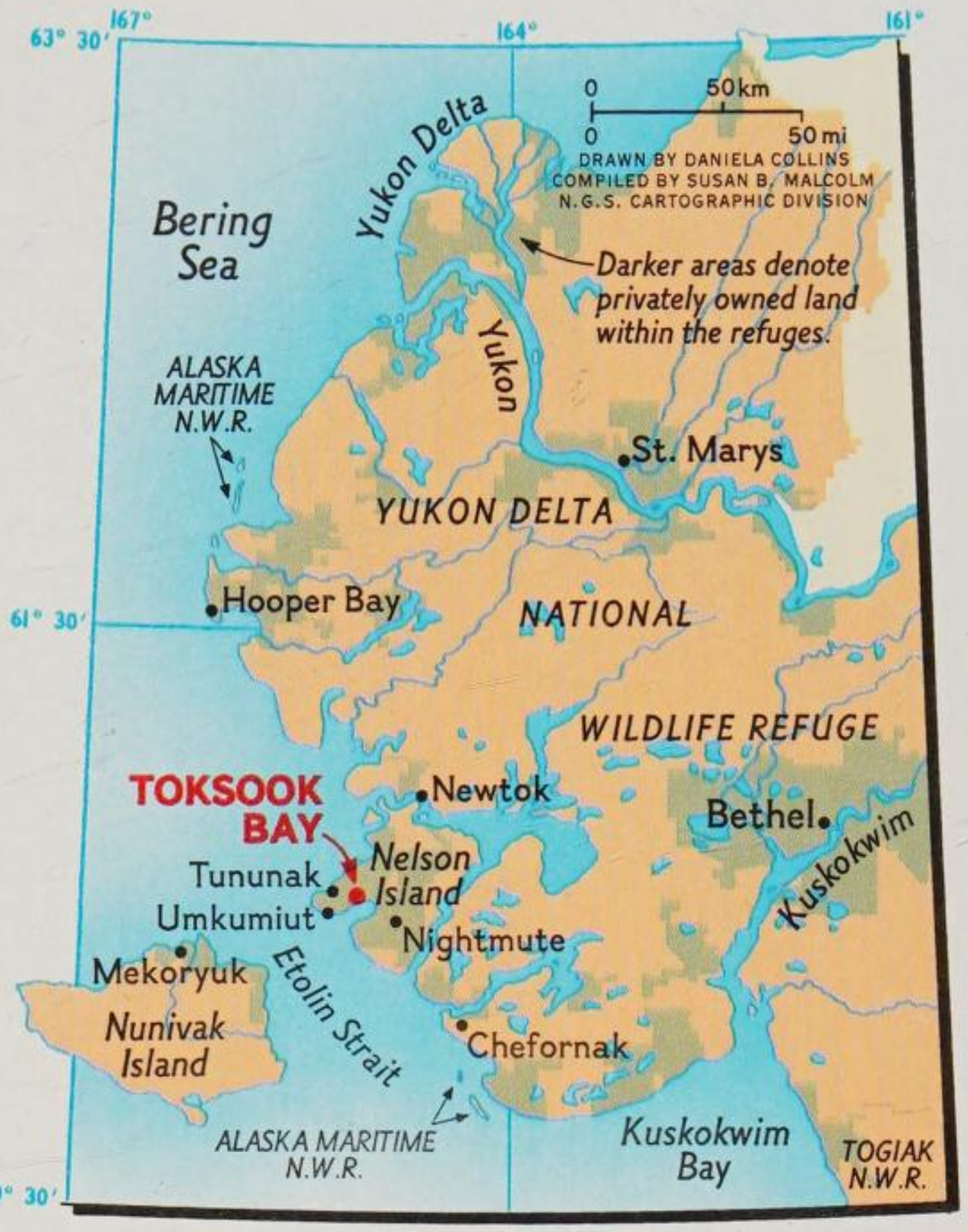
The economics of hunting for food is also a concern. In the ice-free summer villagers take out their motorboats to net herring and salmon. In fall and then in early spring, after the ice breaks up, they use them to hunt seals, ducks, and geese. In winter they chase across the frozen tundra and the bay on snowmobiles to hunt and trap foxes and mink. Snowmobiles and outboard motors are expensive. And gasoline here sells for $2.40 a gallon.

There are only two ways to get gasoline, heating oil, and supplies into the village; both are costly. After the spring breakup, two or three barges chug into the bay, pump gas and oil into tanks on the edge of the village, and unload supplies ordered months earlier, littering the beach with piles of lumber, a new boat or snowmobile, and boxes of canned foods for use at the grade school.

Most goods are flown in from Anchorage aboard the Twin Otters that land on the dirt airstrip daily during good weather. The planes carry mail, passengers, and groceries for Larry John's and David Jimmy's small stores. But air delivery is reflected in the prices. A half gallon of ice cream costs $6; a three-pound box of laundry soap, close to $4; a box of disposable diapers, $15.50. I was amused to find salmon for sale—a 15-ounce can for $3.79.

Salmon is a village mainstay, both for subsistence and income. In May about a dozen men leave their families to journey some 200 miles southeast to Bristol Bay, where the salmon industry is big business. Signing on with the fisheries at Clarks Point, they use their own or company boats to net the kings, reds, silvers, and pinks that swirl into the bay en route to their spawning rivers. On a good day a boat can haul in 15,000 pounds of fish. The cannery gets 15 percent of the catch in payment for its boat.

In a few short weeks the families who fish earn their income for the year, anywhere from $3,000 to $60,000, depending on the catch, whose boat it is, and how many family members work *(Continued on page 822)*



Left to themselves *by the rest of the state, scores of Yupik Eskimo communities dot the coast of the Bering Sea and the broad, marshy deltas of the Yukon and Kuskokwim Rivers. Toksook Bay (population 370) was established on 40-mile-long Nelson Island in 1964, when families from the village of Nightmute moved closer to fishing grounds. The nearby Yukon Delta National Wildlife Refuge shelters half a million wildfowl each summer.*

To share their good fortune, *Anna Asuluk (**above,** left), Darlene Morgan, right, and shy Lucy Asuluk, middle, carry emperor geese shot by Anna's father to friends and neighbors. These birds will probably end up in a delicious goose soup. Dividing with others is a Yupik tradition in the delta region, where four-fifths of the world's emperor geese nest.*

*A well-stocked gun rack (**left**) hangs in the living room of Paul John, a former mayor, whose daughter Agatha plays with his grandson Vernon. Men hunt ducks, geese, and ptarmigan in spring and summer, and seals year-round. In winter they trap foxes, mink, and hare for their pelts. Staple foods, however, are salmon and herring netted in summer and dried for winter.*

They don't close school *just because of snow in Toksook Bay. So on this blustery February morning—with the temperature dropping to minus 10°F—two young girls set off for the grade school down the main street of town. Strong Bering Sea winds like these whistle across the island much of the time, occasionally reaching*

70 miles an hour. If there were a serious storm, parents would escort their children to school or drive them in snowmobiles. There was one stormy morning a few years ago, however, when the principal of the high school couldn't even find the building. That day he called off school.

together. Toksook Bay offers few paying jobs, so Bristol Bay money is important.

Subsistence fishing for salmon around Toksook Bay is also serious business. One afternoon I went out with Joe Asuluk, my companion on the Bering Sea goose hunt, to haul in his net from a nearby river. As we headed upstream, I could see the silver flash of fish below us. We began at one end of the net, tugging and lifting it, pulling the boat along, and untangling the salmon's gills from the mesh. As fish piled higher in the boat, Joe explained the science of subsistence fishing to me. "The woman knows. She tells you when you have enough."

Until then, the men haul in salmon, which the women fillet along the bone and hang over the racks to dry. Once dry, the fish are stored in baskets or boxes until needed.

When salmon or herring are running, Toksook Bay is a busy place, families working together, each member at his or her traditional task, laying in food for winter. Father and son handle the nets while mother and daughter clean the catch. Villagers often set up camp close to a favorite fishing site. With boats of families leaving and returning daily, the pink flesh of drying salmon, the silver of herring on the racks, the barking dogs and playing children, the village takes on a festive air.

Yet hazards are always present. Villagers tell of times when they dragged the bay, searching for the body of a fisherman who fell overboard in heavy seas. Elders remind youngsters how to save themselves in winter storms by burrowing in the snow.

Where the livelihood of everyone depends so much upon the role of each . . .

Families are strong in Toksook Bay. Where the livelihood of everyone depends so much upon the role of each, the members of a family form solid and lasting bonds. Rarely does anyone move away from family and village. Only about a dozen students have left to attend the University of Alaska in Fairbanks. Until recently, no one had stayed the full four years. The strange city environment, language problems, and homesickness make for slow and often discouraging progress.

Respect for authority in the village runs deep. In their Yupik language the same word means both listen and obey. When children listen to their parents, they obey them. Parents do not argue in front of children, nor do they physically punish them. Instead they prefer to talk with a child until he realizes his behavior is wrong.

But when parents drink, they forget their gentle ways. The villagers are alert to the problems of alcoholism. Like most other villages in the region, Toksook Bay prohibits alcohol. But those who want to drink know where to find bootlegged liquor and homebrewed beer.

In a village 100 percent Catholic, divorce is almost unheard of. People take their religion seriously and do not relegate it merely to Sunday morning. Nick Therchik and Bruno Chakuchin are deacons in the church and direct prayers and Communion services when Father Dick Case, their priest, is off to one of the two other villages that he serves. At least once a year the people of Toksook Bay sponsor a religious rally—a weekend revival when Eskimos from surrounding villages come to share songs, spiritual talks, and prayer.

Village children are expected to pull their own weight and to contribute as much as possible to the family's welfare. When a boy shoots his first seal, his mother will host a seal party, dividing the meat and blubber among the other village women and giving out prizes of seal oil, rice, sugar, cloth, and toilet paper. When a party is announced, guests gather outside the door and the mother of the young hunter distributes the gifts, tossing armfuls of them up in the air. Laughing, the women will scramble like children to catch them.

Mark John was taught to fish and hunt by his father, Paul. When Paul served as mayor, he left the hunt for food up to his sons. Mark, unmarried in his late 20s, is still responsible to his family.

"Our family is like a chain," Mark explained. "When you are unmarried, you are inside the chain and you contribute to it. Last year I made good money fishing. I gave it to Dad. He gives me enough to live on and a bit more, since I'm oldest. I've saved

enough to fly to Anchorage and to visit friends in other villages. When you marry, it's different. You begin your own chain."

Yupik, one of the two basic Eskimo languages in Alaska, is the common tongue of the village's 65 families, although all but the very old and the very young speak some English. Children learn English in the grade school. Wilma Moore, its principal, explained to me that in other villages the first three grades are often taught in Yupik, but in Toksook Bay the parents want the children to get English right from the start. By the time they reach high school, they are almost as comfortable with English as with their own language.

In 1976 a two-million-dollar high school was built in the village. Students no longer have to travel to St. Marys, the boarding school 125 miles north in the Yukon Valley, or even farther to the Chemawa Indian School in Salem, Oregon. Nelson Island High School teaches English, math, and science, as well as home economics, typing, and shop. In addition, traditional crafts and dancing are offered.

At first glance the boys, dressed in T-shirts, blue jeans, and tennis shoes, could belong in the classroom of any American high school. But the girls wear long earrings of carved walrus ivory and parkas with heavy wolverine and white fox ruffs. And a line of snowmobiles replaces the parking lot full of cars.

The boys hunt and fish, the girls help their mothers around the house, take care of younger siblings, and in summer gather berries and other foods. Other than that, there is not much for teenagers to do. There are sports, of course, at the high school during the school year. In fact, during the long, dark winter the school gym is a center for recreation for adults as well as youths. Toksook Bay plays basketball tournaments with other high schools, and men form teams to challenge nearby villages. For the boys there are also traditional sports, enthusiastically played at local youth olympics.

Once a year the high school sponsors a carnival, with cakewalks, darts—even a mock jail (the mayor, village councillors, and the priest are its most popular prisoners!). In the late spring the students decorate the gym with streamers of crepe paper, bright stars, and a poster proclaiming "We may never pass this way again." They elect a king and queen, who dance the royal dance wearing their crowns—just as in any other high school on prom night.

The village council voted to allow two dances a month in the community hall, and they're well attended, with taped music by the Bee Gees and Kiss blasting through the darkened room. The night may end with a couple walking hand in hand past the edge of town and down the dirt airstrip—always keeping one ear tuned for the siren that blows every night at eleven o'clock, signaling a curfew for anyone of high-school age or younger. Before the siren was installed, the church bell rang the curfew.

Still, he dreams of moving to Fairbanks . . .

When Gabriel Chagluak graduated from the high school, he was lucky enough to get one of the few jobs open to a young person—as a teacher's aide in the grade school. Still, he dreams of moving to Fairbanks, to attend the University of Alaska, see stores, and learn to drive a car. "Then I would learn all the streets around and drive to Florida."

But Gabriel's father is in poor health and unable to do the hunting and fishing the family depends on, so Gabe and his brothers remain in the village to care for the family.

Eva Nevak is another Toksook Bay high-school graduate. She has probably traveled farther from the village than anyone else her age, having visited friends in the southwestern states. One summer she spent two months in Bremerton, Washington, with Tom and Leslie Dolan, former teachers at the high school in Toksook.

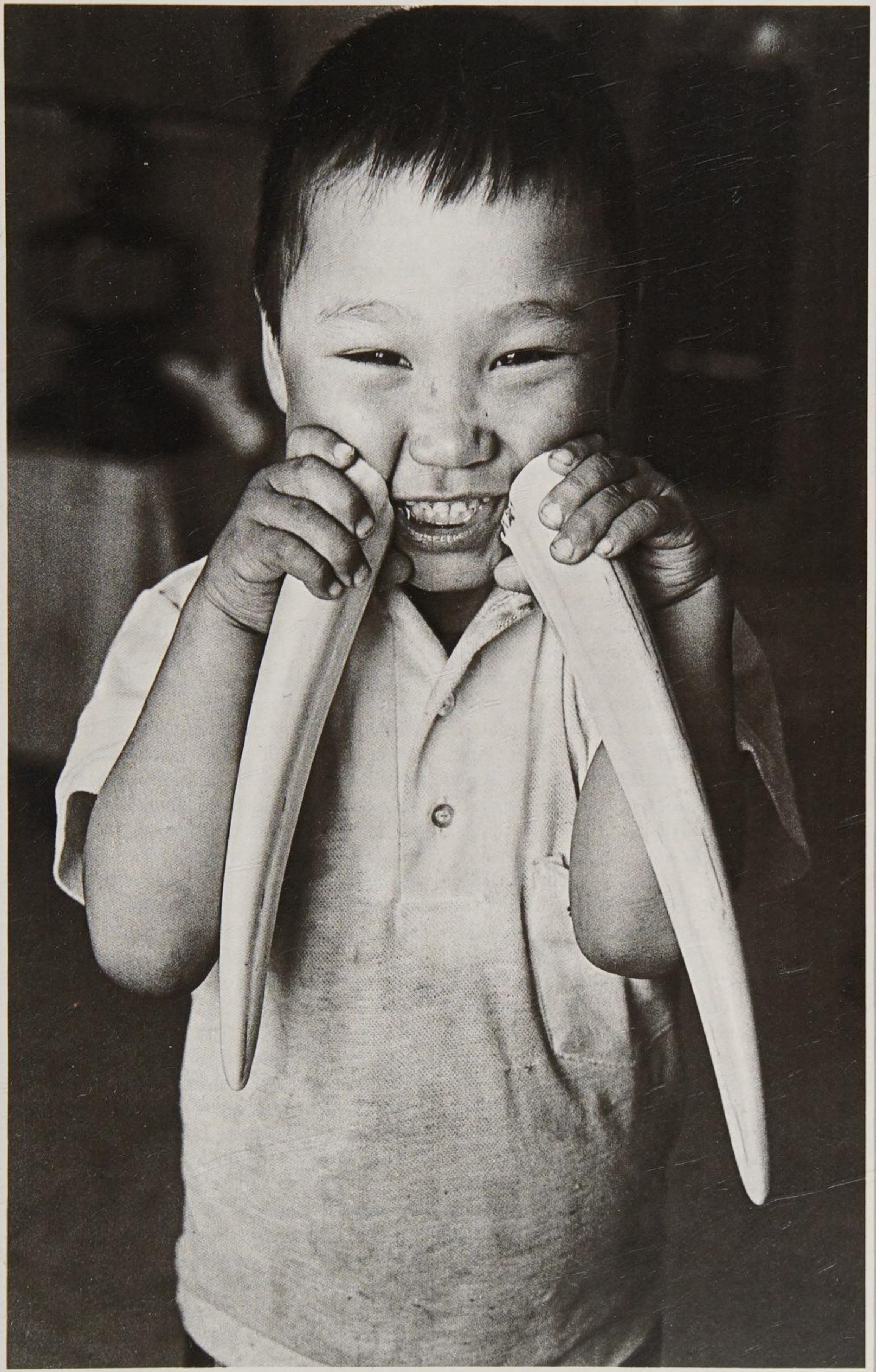
I saw Eva in Bremerton during the baptism of the Dolan's twin baby boys. She has a winning smile, made even more so by dimples. Wearing a soft, flattering dress and a borrowed pair of high heels, she looked at home with other guests. But she spoke wistfully of her mother's weekly phone calls, when they could speak in Yupik together. She talked of going back to the village, where there are not so many people always in a rush to go somewhere, no cars, no frightening traffic *(Continued on page 828)*

Through the small, bright screen *the world comes to Toksook Bay. After a television tower at Nightmute blew down a few years ago, videocassettes became a prime way for villagers to get impressions of life in the rest of the country. Storekeeper Larry John was first to buy a cassette player—his library now holds 140*

*movies—but at least 20 families soon followed suit. In the living room behind John's store (**above**) Simeon Julius, left, and John Alirkar spend a few moments watching cartoons with neighbor children. Reception from Nome and Bethel has since resumed, but TV still takes a backseat to bingo as the town's favorite pastime.*

A toothy smile *brightens the face of Fritzie Nevak (**facing page**), who holds walrus ivory that his father, George, will carve into earrings, bracelets, or links for wristwatch bands. His work has been shown in a touring exhibit of native crafts sponsored by the Alaska Council on the Arts. Nick and Laura Therchik (**above**) wear the handiwork of Laura's sewing. Their mountain-squirrel parkas kept them warm on this chill morning in the Roman Catholic church, where, with the heater broken, it was so cold that the holy water froze.*

*Fingers make the difference for Nancy Chanar (**right**) as she tests her skills on a computer programmed for first-grade math. At her age children also start English lessons at school. Most families in Toksook Bay speak Yupik at home and on the street, though all but a few old-timers know some English.*



or noises, and where the air is clean. It was then I realized that the life of the youngsters in Toksook Bay was slow and sedentary in my mind, but not necessarily in theirs.

"B-14 . . . I-23 . . . N-47." The numbers on the bingo board light up as a village woman calls the numbers for the players filling the community hall, the other center of village activity. Bingo, played two days a week, is the village's only regularly scheduled social event. Sitting cross-legged with a bag of markers close at hand, players spread their cards in tidy rows on the floor. Most keep a soft-drink can handy for spitting. Men, women, and children—practically the entire village—dip snuff. The children begin as early as two. It is a common sight to spot preschoolers toddling around the players, the telltale worn circle of the snoose can in their back pockets.

Movies are occasionally shown in the community hall, projected against a white wall at one end of the meeting room. The films, ordered from a distributor in Anchorage that specializes in servicing villages, are all family fare, so everyone is welcome.

Soon after the showing is announced, families begin filing toward the hall. The children crowd up front on the floor, squirming, laughing, sharing candy and soda with one another. Their parents sit on the floor behind them; the older ones are given folding chairs. All the way to the back cluster the teenagers.

The film starts, the noise dies down. The Eskimos are an appreciative audience, laughing and applauding as the scenes unfold. During scary scenes, like the evil witch creeping toward Sleeping Beauty's house, the smaller children cover their ears in terror. Even if there is no loud noise, they cover their ears but never their eyes.

While watching a very popular film about the Vienna Boys' Choir, I could not understand the uproarious laughter at scenes that did not strike me at all funny—until I realized that each of those scenes included a boy with freckles and curly, bright red hair, characteristics unknown in a village of brown skin and straight black hair.

Movies are always a big draw. But an even bigger event took place when the entire village gathered to celebrate a wedding. At the reception we feasted on seal, mink, and *akutaq*. Akutaq—Eskimo ice cream—is made of berries and shredded salmon whipped in seal oil, a delicacy that is definitely an acquired taste. After the meal the groom stayed for the showing of Walt Disney's *The Littlest Horse Thieves,* while the bride went off to visit with friends.

Toksook Bay now has television reception, although videotapes remain popular. Nearly half the families have videotape machines, and they trade shows back and forth. The youngsters love cartoons, and the older children, kung fu movies. The adults watch them all, from *Towering Inferno* to *Every Which Way But Loose*. Before TV, news came mainly through the two radio stations that can usually be tuned in from Nome and Bethel. Newspapers and magazines arrive regularly at the high school, but I saw only one family in the village with a subscription to the *Times* from Anchorage.

Villagers are well aware that the outside world is changing their lives.

Toksook Bay may not be reading the news, but the villagers are well aware that the outside world is changing their lives. First came the Alaska Native Claims Settlement Act—and then the prospect of Bering Sea oil discoveries. Both stimulated villagewide discussion. It seemed when we were not in the community hall for bingo or a movie, it was for another meeting.

The settlement act of 1971, in attempting a just distribution of land and money to Alaska's natives, has wrenched them into the hard realities of 20th-century economics and politics. Suddenly a village without television or cars was joined with similar villages into a multimillion-dollar corporation.

Alaska's Eskimos, Indians, and Aleuts were given 44 million acres of land, a little more than ten percent of the state's total acreage. They were also awarded 962.5 million dollars for claims on the rest of the land. The federal government organized the native population under 13 regional corporations to distribute funds to the 200 eligible villages. These also formed corporations, with the villagers as shareholders.

The Eskimos of Toksook Bay each own one hundred shares in Calista, the regional corporation, and equal shares in the village corporation, Nunakauiak Yupik.

The Calista Corporation, second largest of the regional corporations in size of landholdings, number of shareholders, and total assets, has investments in Alaska, including the luxury-class Sheraton Hotel in downtown Anchorage. After several years of multimillion-dollar losses, the corporation turned its finances around, making a profit and paying dividends to shareholders for the first time in 1982.

While relatively little money has as yet filtered down to the individual, the Eskimos spend a great deal of time and energy discussing everything from offshore oil drilling to the dangers of snowmobiles speeding through town. Meetings are usually bilingual, for the benefit of the whites who fly in to counsel and inform.

In 1979 the federal government informed villages in the region it would accept bids for leasing drilling rights to companies interested in exploring for oil in the Bering Sea. As part of the coastal-zone management program, a board to represent local interests was elected from the villages in the Yukon Delta region.

In January 1981 chartered planes from the distant villages landed on the Toksook airstrip, while snowmobiles from the nearby villages roared into town. The board was meeting here with representatives from Nunam Kitlutsisti (Protectors of the Land), a group from Bethel advocating the subsistence life-style for Eskimos.

The group's director, Harold Sparck, told the meeting, "Keeping New York City lit and operating the air conditioners in Los Angeles is the reason for these leases."

Few, if any, of those attending had been to New York or Los Angeles, and with a wind howling across the snow-swept tundra, it was difficult to connect Toksook Bay to those distant, foreign places.

As he talked, Harold flashed slides of oil rigs, tankers, and acres of stacked pipe. "The land, the water, and the air are never the same again," he asserted. "Oilmen make noise and spill things into the water. Even when they try to be careful, they are going to change things."

One of the representatives from Mekoryuk quoted from a newspaper article on oil prospects in the Bering Sea, translating it effortlessly into Yupik. He feared that the oil companies would want to build a deepwater base on his island, Nunivak.

Although the first exploration drilling will be to the north of here, Eskimos in the Toksook area believe that their subsistence livelihood may eventually be upset by environmental damage.

Will the oil companies listen to his people's problems and honor their promises? an Eskimo asked.

As the meeting progressed, the Eskimos began to realize the inevitable—that more people will be coming into their area, whether or not they want them, that the oil companies' interests in the resources under the water conflict with their own interests in the resources within the water. And while they might not understand all the complexities involved, they feel the pressures.

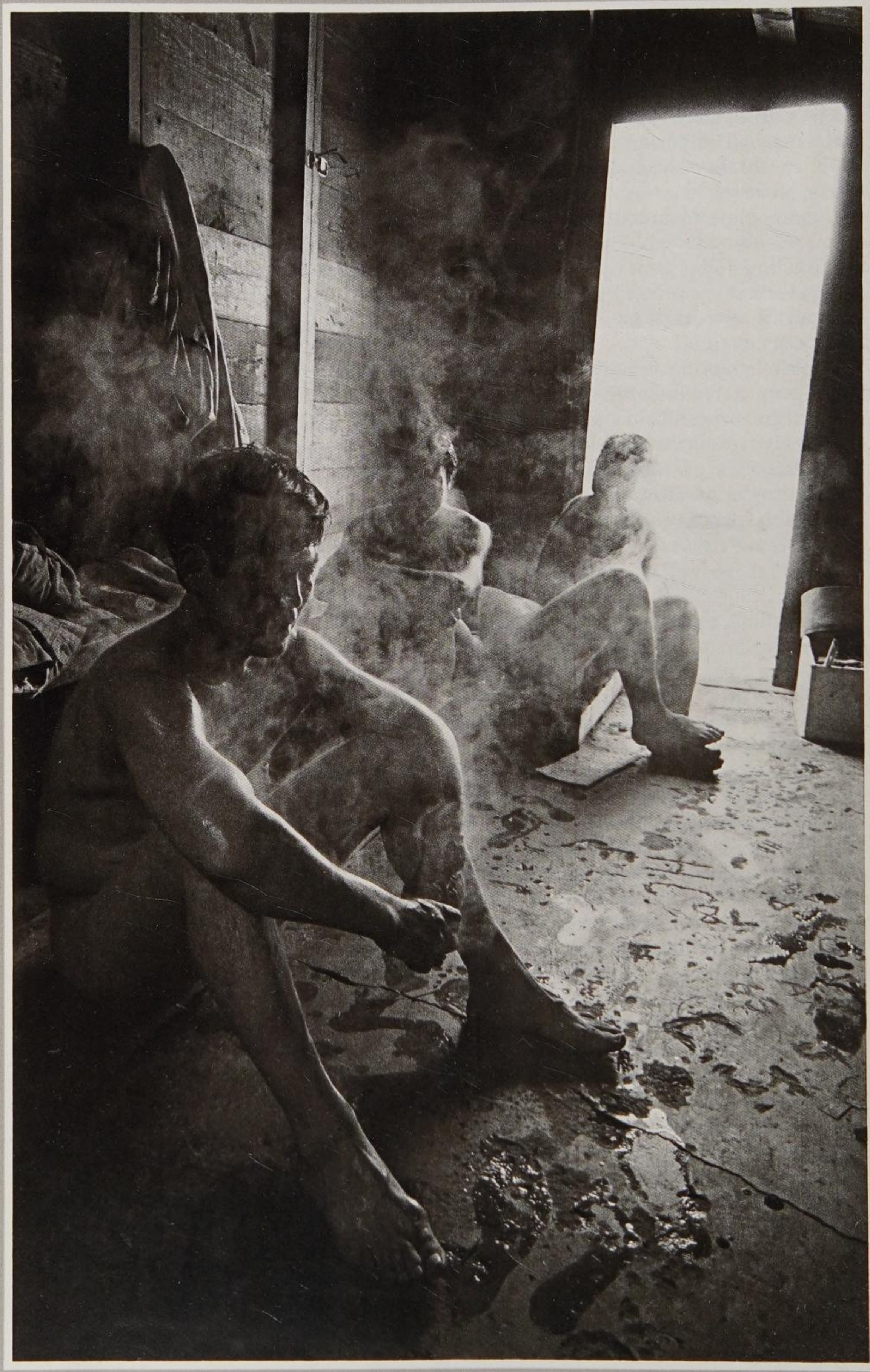
Will the oil companies listen to his people's problems and honor their promises? an Eskimo asked.

Harold replied, "If you're strong enough—and have a shotgun in your hand."

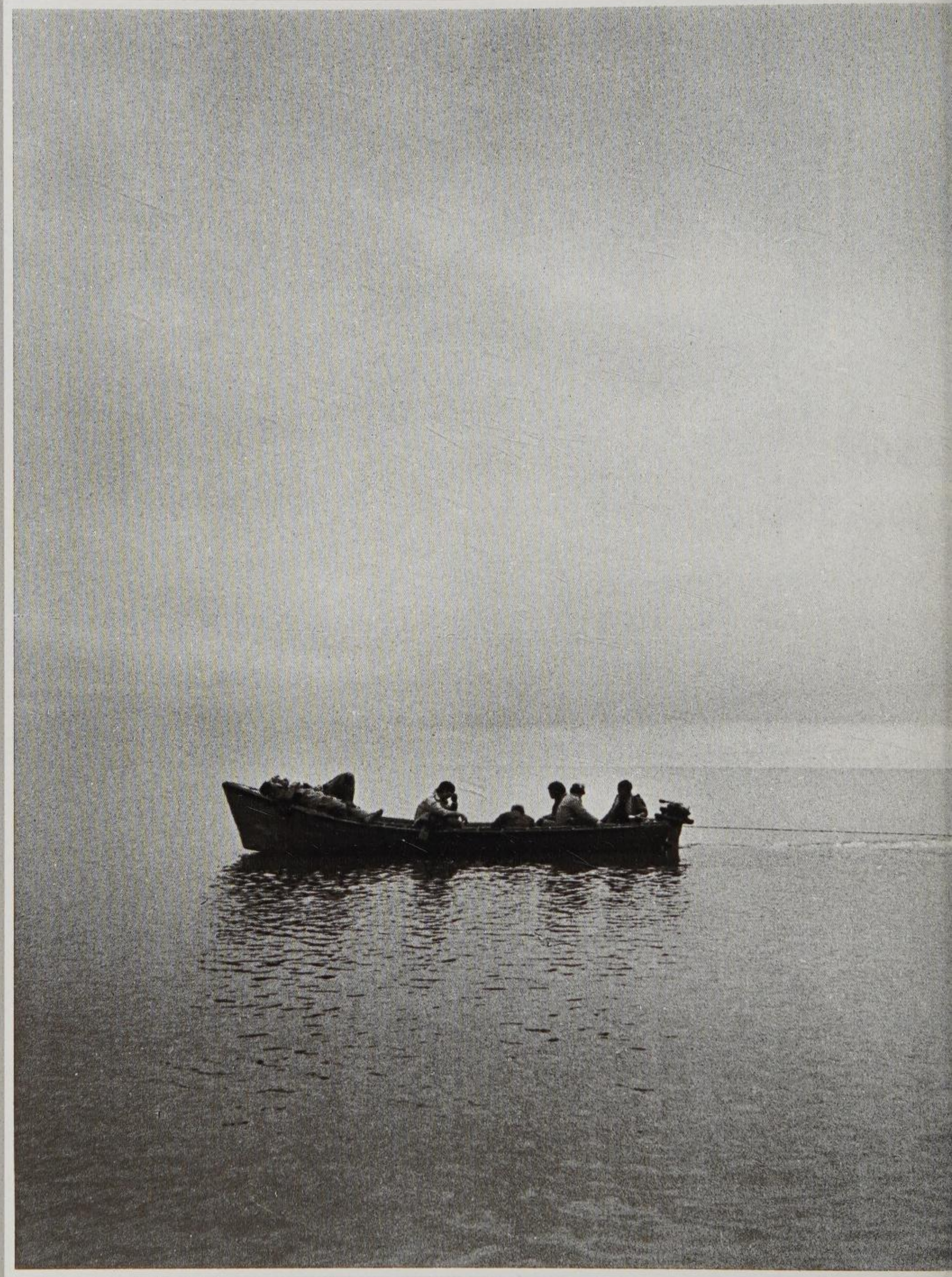
After listening for hours, Mayor Paul John rose to express the feelings of many there: "The oil people do not care about fish, the seals, and the birds. They will come for oil to make money so they can eat their kinds of food. They eat through money."

Attentive to the needs and concerns of his village, Paul worries over many changes he sees, such as the village youth turning away from a subsistence life-style. "This is because they have gone out to college and the cities," he says, "living with *kassaqs* [whites]. Unless they relearn to eat the fish foods, some of the young may starve." Recalling a time before canned fruit and packaged cookies, Paul continues to rely upon what the land provides, all the while warning that the store-bought foodstuffs may someday disappear.

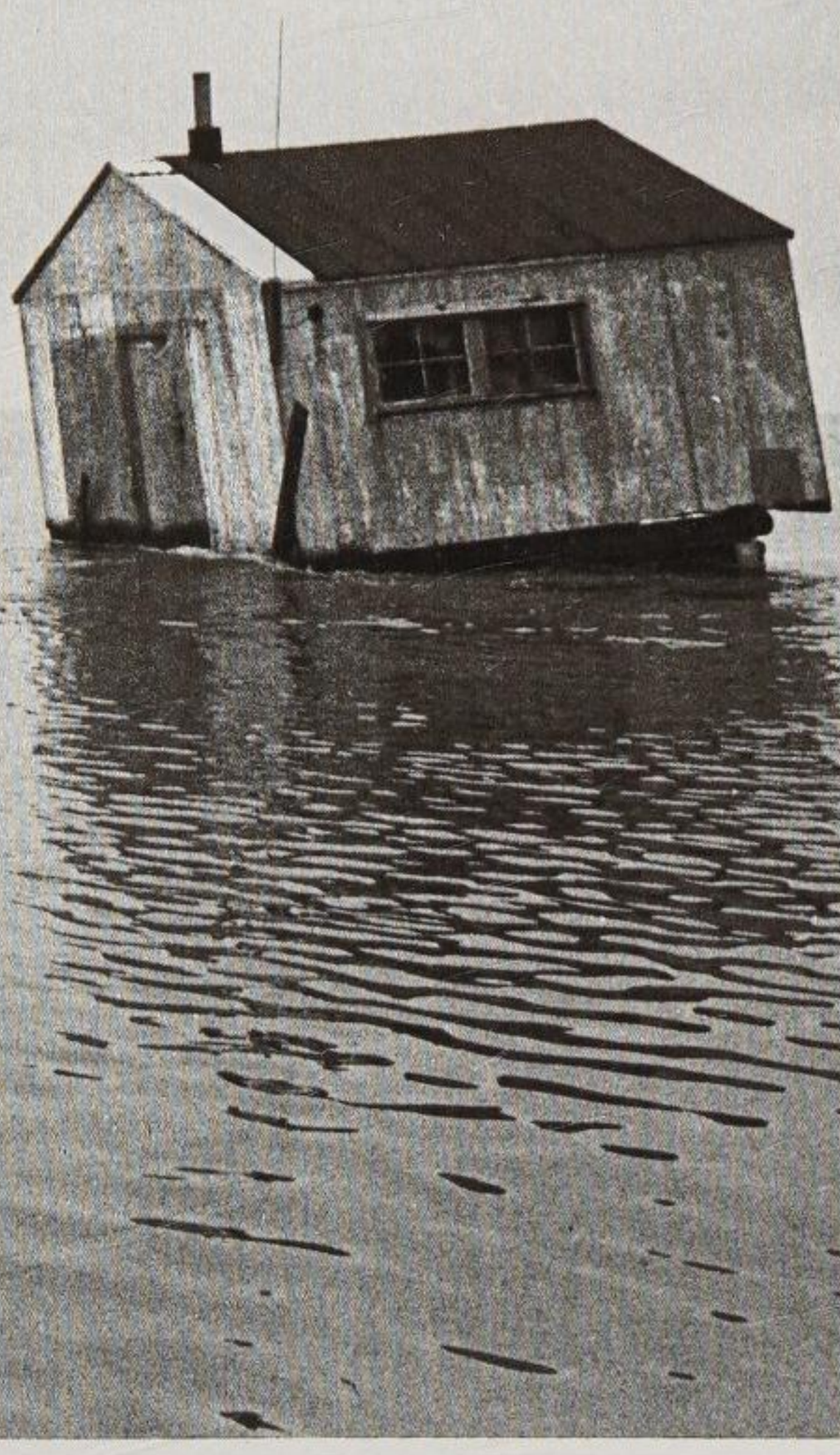
Paul John and *(Continued on page 834)*



*"**Eyes and ears of the north,**" young men like Jimmy Aiaginar (**above,** left) and Ralph John serve proudly in the National Guard, which also earns them extra money in a cash-poor society. Many families rely on income from commercial salmon fishing in Bristol Bay to supplement a subsistence living. Workers there earn a year's pay in a few weeks each summer. Nick Chanar (**left**) and fellow crewmen relax at Clarks Point after a day on the water. Steam bathing is a traditional and sociable way to keep clean.*



To turn his house into a boat, *Ben Chagluak loaded it onto 55-gallon drums and towed it from the old fishing camp at Umkumiut to Toksook. His father and fellow founders of the town did much the same thing 20 years ago when they moved across Nelson Island from Nightmute; other residents waited until winter*



to drag their one-room dwellings over the ice with dog teams. Government-built housing later doubled the number of homes sheltering the village's 65 families. A determination to make their lives better prompted their first move. It still contributes to the success of Toksook Bay.

the other elders worry that their children are losing hold of the Eskimo traditions. They sound that warning regularly at their meetings. "Losing our culture." The phrase also kept arising like a refrain at a meeting of the youth organization. Said one girl: "Losing our culture, our roots, is like weakening us. What will our kids have to look back on? Will they know where they came from?"

But little of that meeting dealt with the old ways. Instead, they planned their next dance, discussed speed limits for snowmobiles in the village, and talked about opening a snack bar. "So we can get money to go where we want to go," as one high-school boy put it. "Or get what we want to get." He smiled. "Like planes."

Simeon, Paul John's second son, is married and raising a family. He continues subsistence hunting and fishing, but he also teaches in the Headstart program. He says: "Our folks expect us to live like them. They had to cut firewood—we were raised with stove oil. My dad lived in an old mud dugout. Sometimes they don't understand us."

> "Our folks expect us to live like them. . . . Sometimes they don't understand us."

A month after the meeting on oil leases, villagers gathered in the hall to talk with representatives from Alaska's Department of Fish and Game. Introduced from a nearby island two decades ago, Nelson Island's musk-ox herd had outgrown the food supply and needed to be thinned by some 20 cows. But who would hunt them?

Ed Shavings, an Eskimo guide from Nunivak, was flown in to tell the men of Toksook Bay how they thin the herd on his island. He said that big money could be made from the game hunters, who arrive from the world over for an opportunity to shoot a musk-ox. Not that there's all that much suspense to the hunt. When cornered, a herd backs together into a defensive huddle, immobile and helpless against guns.

But since only a few were to be killed that year, the hunters would be chosen by lot. Permits for Alaskan residents run $25. For out-of-state hunters, a thousand dollars.

On Nunivak, sportsmen pay another $3,000 to $5,000 for a guide, use of a snowmobile, food, and a night's lodging in the guide's home, since there are no hotels. The sportsmen take only the head and hide of the animal, leaving the meat for the village. So, in addition to the money, Nunivak residents still get the food.

"Sometimes they're so happy with the trophy that they tip you $200, $400. Those businessmen!" said Ed Shavings wonderingly.

But the attitude on Nelson Island is different. Bob Pegau of the Department of Fish and Game tells me: "Here the people are much more possessive about their animals. They're not so open to outsiders as the people on Nunivak."

To make as sure as possible that the animals will be hunted by Nelson Island people, the elders decide that every villager should put in his name, stacking the odds against an outsider being chosen.

The February morning of the drawing is 15°F below zero. Even if anyone from the outside wanted to be there, planes cannot land because of the strong, gusting winds, which send the chill factor plummeting to minus 65°F. At 8 a.m. it is still as dark as night, but I see huddled figures, bent double against the wind, moving toward the community hall. There is trouble getting its oil heater working, and people keep their parkas on. Men bring their wives, and children on their way to school drop by to write out their names and drop them into a five-gallon paint can.

Then, everyone turns to me—the villagers have agreed among themselves that I am impartial enough to draw out the names. One by one I pull out 20 slips. The names are all from Toksook Bay and nearby villages. To the disgust of the hunters, they include eight high-school youths and two grade-school girls. The rest, though, are men.

After the Fish and Game representatives have issued permits, Paul John stands for attention. In Yupik he announces that the village leaders have decided that the musk-oxen will be shared equally among all the people, as are the first salmon, seals, and other game brought into the village.

There is no discussion. In Toksook Bay the old ways still come first. □

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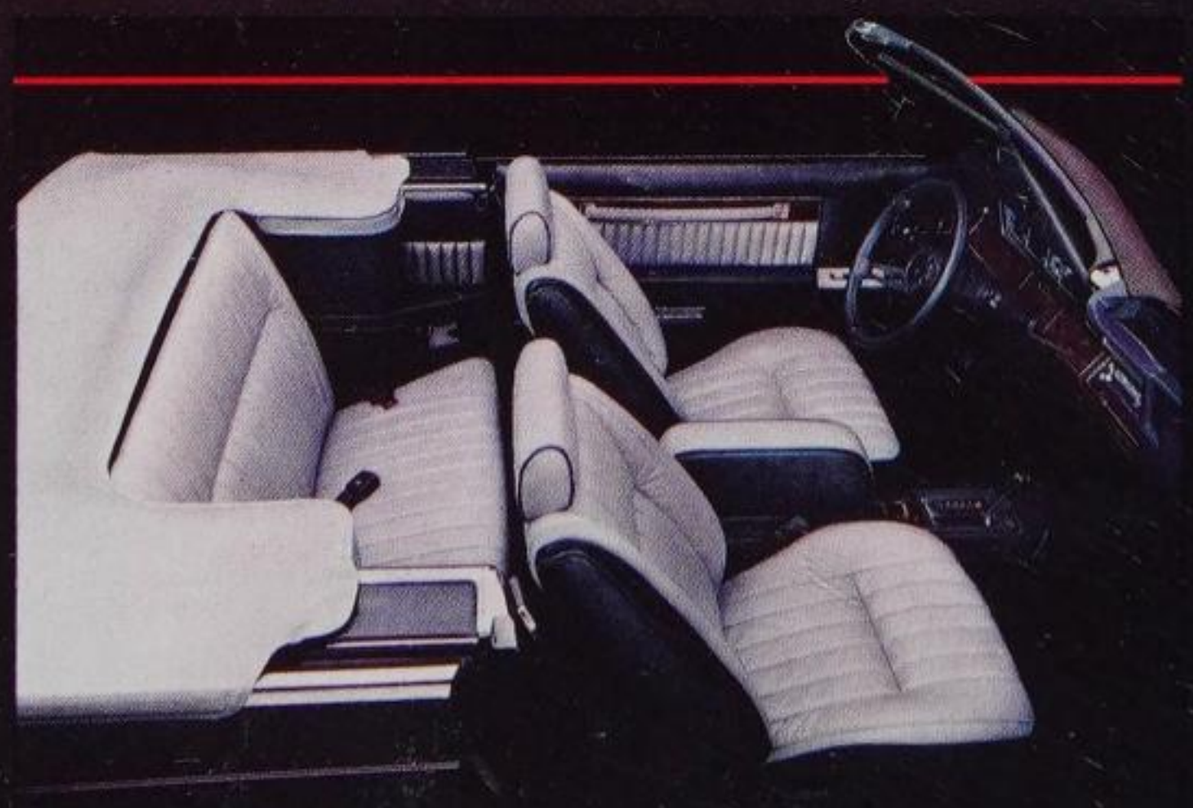

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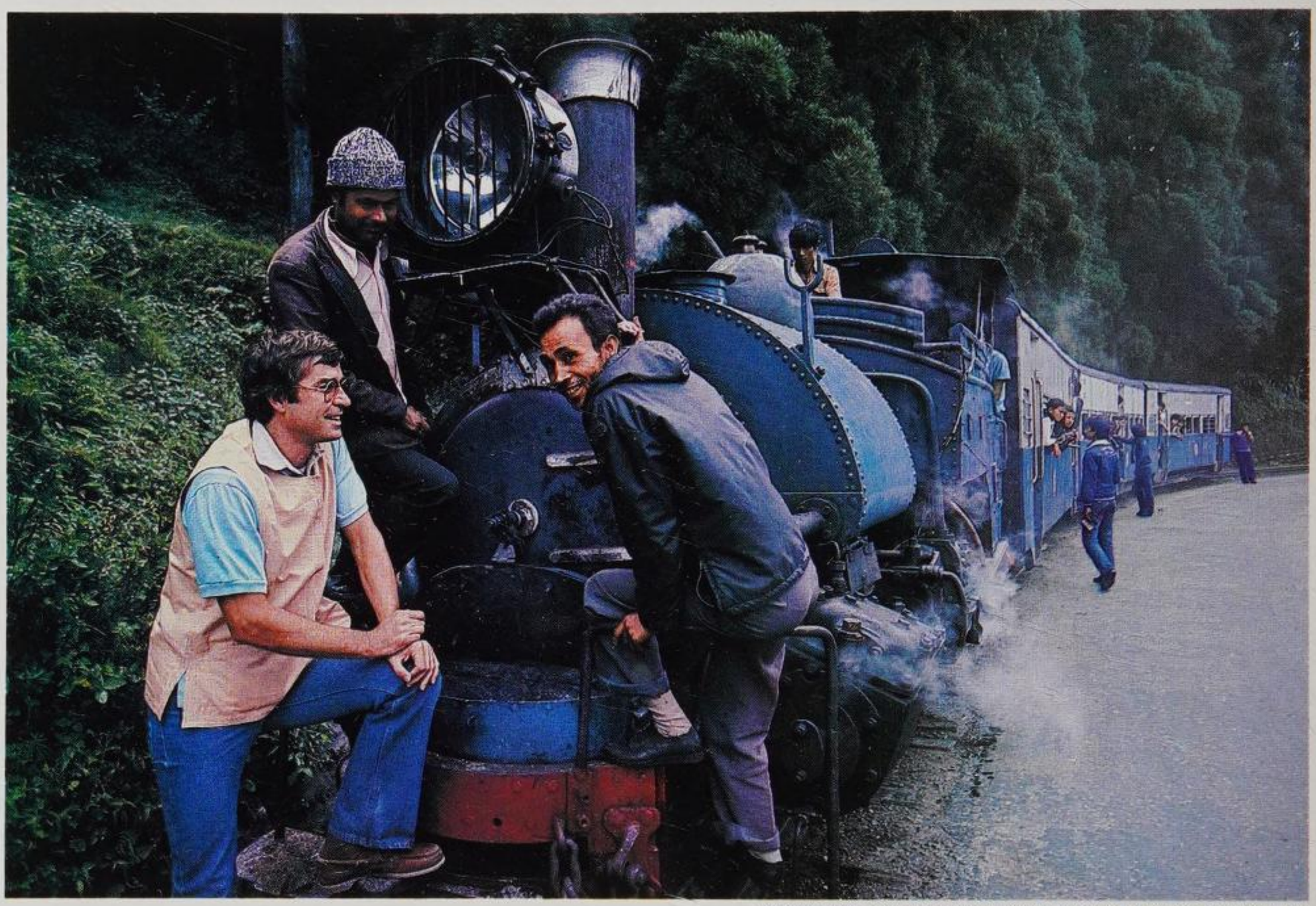


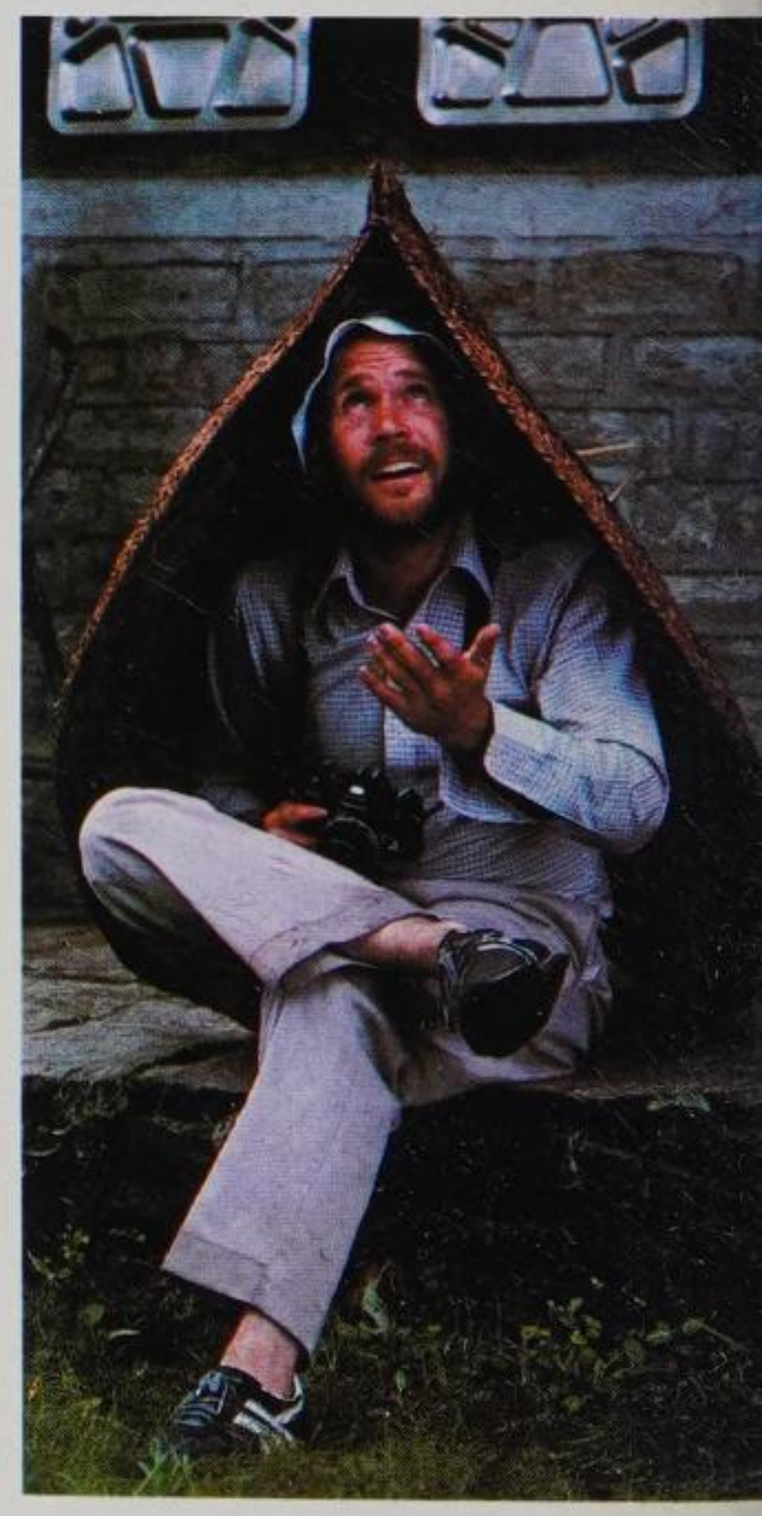
PHOTOGRAPHS BY STEVE MCCURRY (ABOVE) AND LAUREN STOCKBOWER

THE LITTLE ENGINE THAT COULD still can, best-selling author ***Paul Theroux*** finds as he interviews employees of the "toy train" that climbs Himalayan foothills to Darjeeling on a century-old narrow-gauge railway (***above***). "Every passenger was either a Buddhist monk, a schoolchild, or a little old lady with a chicken going to market," he recalls. In Darjeeling's heady ethnic maelstrom he found Tibetan artifacts carved from yak vertebrae—"but I drew the line at buying others made from a human tibia."

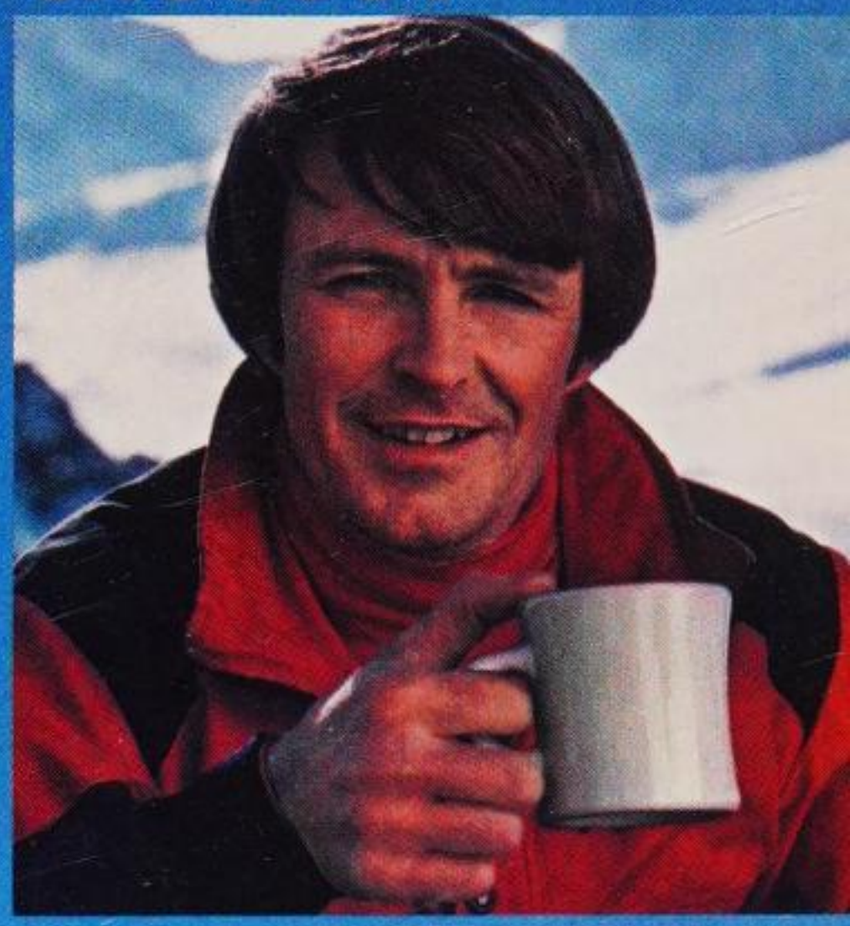
Riding the rails from Pakistan's Khyber Pass across India to Bangladesh was vintage Theroux. Massachusetts-born, he joined the Peace Corps to teach in Africa. His 20 books include *The Great Railway Bazaar,* which chronicles a pan-Asian train trip; *The Mosquito Coast,* set in Honduras; and *The Kingdom by the Sea,* about Great Britain, where he now makes his home.

Keeping his camera dry and his hands free in a downpour, ***Steve McCurry*** dons a shield of straw popular in parts of India and Nepal (***right***). A Pennsylvania native, Steve's free-lance images often reflect a passion for the Middle East and Asia. His work in Afghanistan won the Overseas Press Club's gold medal in 1980.

Aboard Indian trains, suffocating crowds sometimes forced him to join riders on car tops. "Once I was photographing and didn't see some low electrical lines," he says. "One hit me in the back of the head and knocked me down, but fortunately not off the car."



"What other coffee would I choose?"



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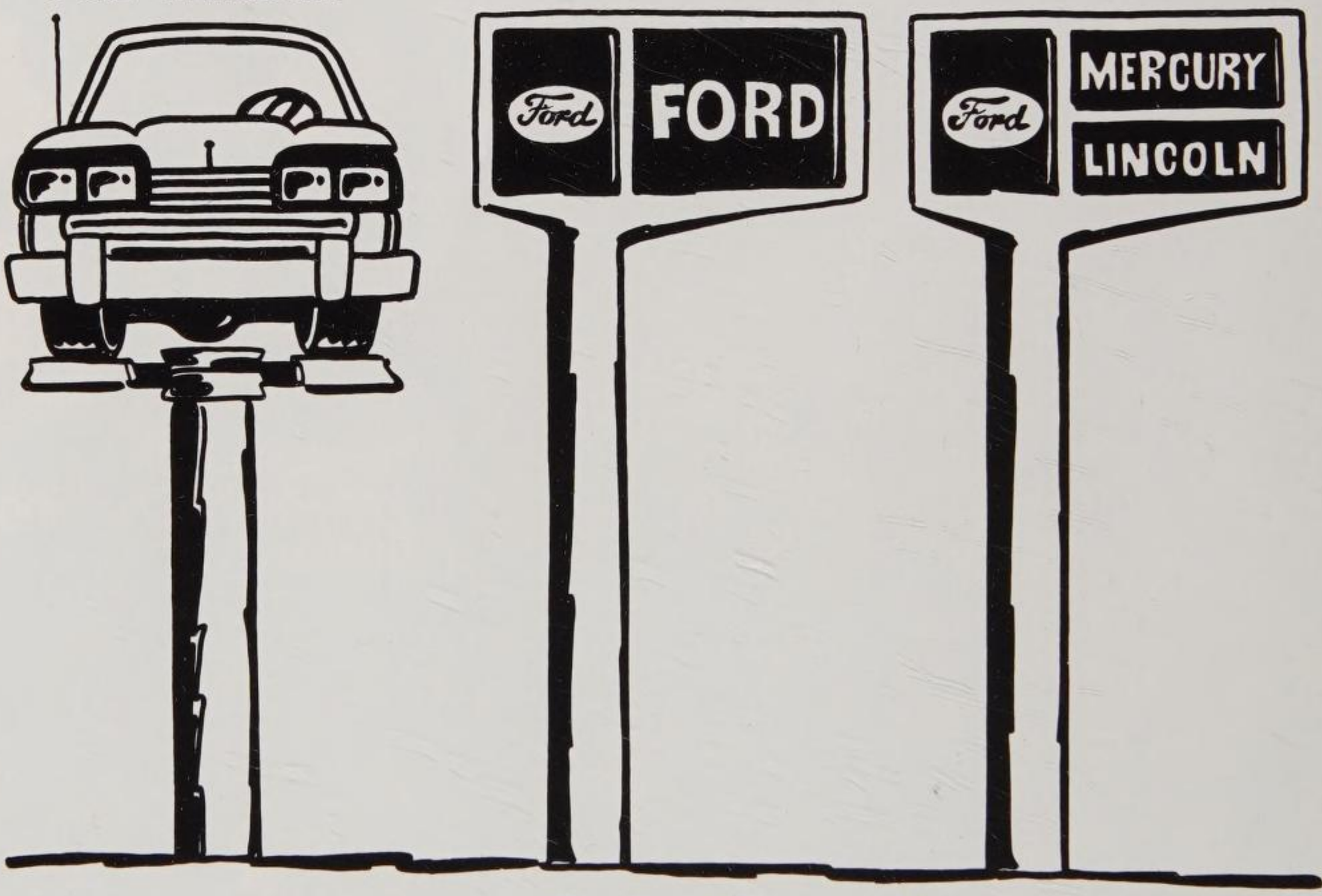

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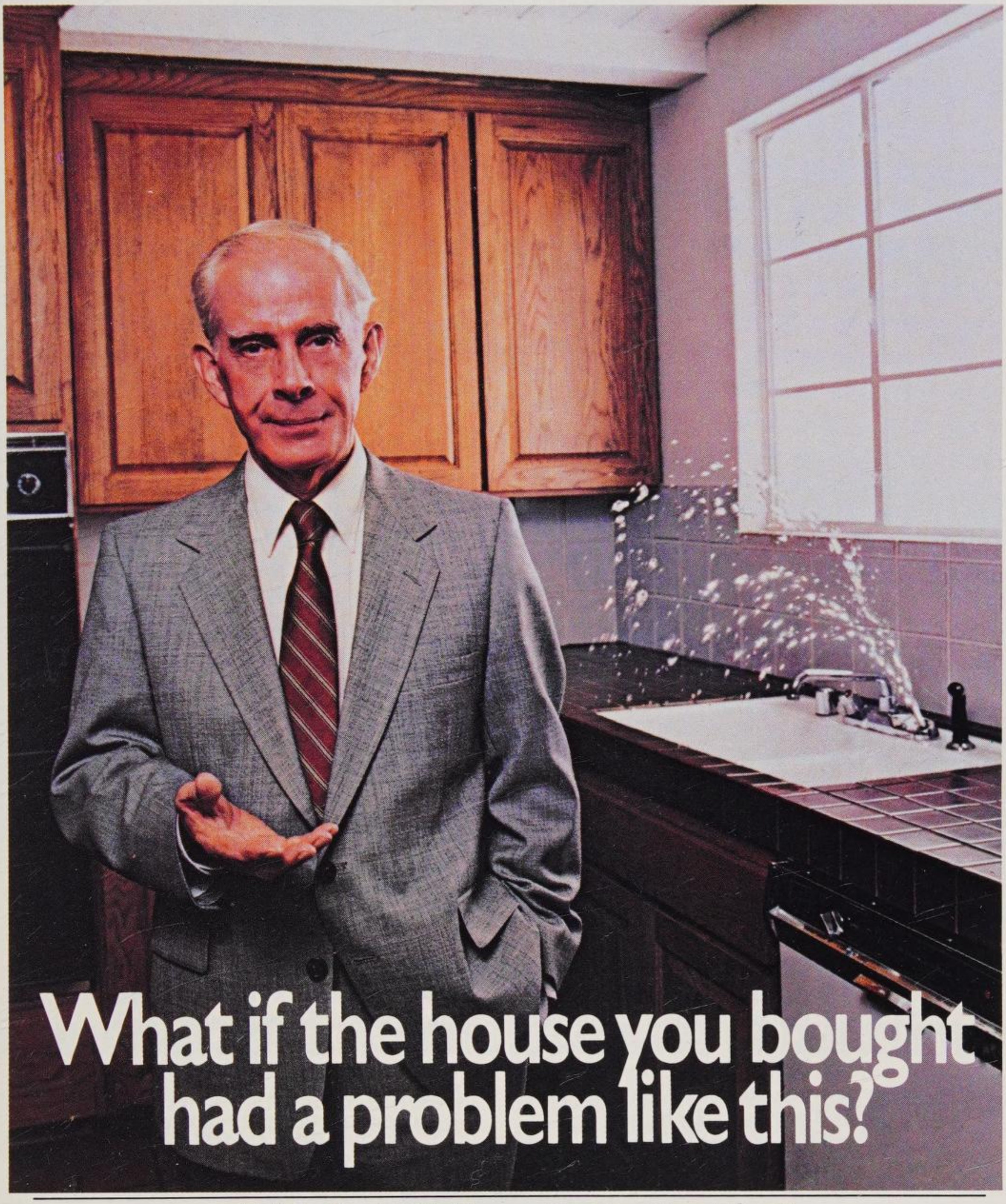

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Photographed by Jean-Paul Ferrero. ***Leadbeater's Possum:*** ***Genus:*** *Gymnobelideus*
Species: *leadbeateri* ***Adult size:*** *About 15cm long with 25cm tail* ***Adult weight:*** *Average 150g*
Habitat: *Regenerating mountain ash forests in the central highlands of Victoria, Australia*
Surviving numbers: *Unknown; small populations are widely dispersed within their range*

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Nesting in holes in mature mountain ash trees, the Leadbeater's possum is a nocturnal marsupial that feeds on insects and gum of acacia trees. The species was presumed extinct until 1961, when it was "rediscovered." Although it has been sighted in significant numbers since then, this endangered animal continues to fight for survival.

The Leadbeater's possum could never be brought back should it disappear completely. And while photography can record it for posterity, more importantly photography can help save it and the rest of wildlife.

Information is needed to help insure the survival of the Leadbeater's possum, but shy and very hard to find, it is an extremely difficult subject to study. Photography can help scientists and conservationists gather the necessary information.

In addition, photography can bring people the otherwise inaccessible beauty of the Leadbeater's possum. By seeing its beauty, people could obtain a better understanding of not only this rare animal but the whole of nature.

And understanding is perhaps the single most important factor in saving the Leadbeater's possum and all of wildlife.

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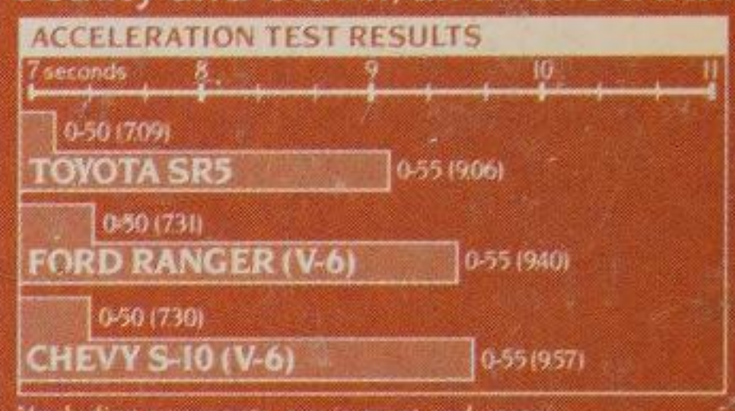

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